SEPTEMBER 1959—SIXTY-SIXTH YEAR

Machinery

NOW...QUENCH GEARS FASTER AND BETTER THAN EVER BEFORE!

...with this new Gleason Quenching Machine!

- Fully automatic
- 3 times faster
- Minimum distortion
- Positive control of hardness and uniformity
- Easy to set up and operate

SEE PAGE 109 ...

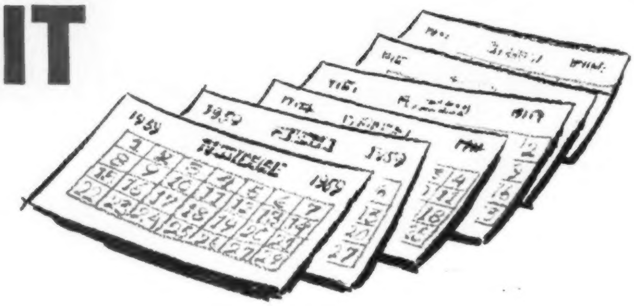
GLEASON WORKS

1000 UNIVERSITY AVE., ROCHESTER 3, N.Y.

WHY WAIT

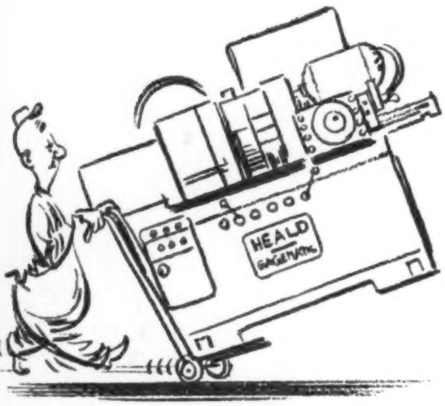
longer

for a new machine?



Chances are, Heald has it

IN STOCK!



As a result of Heald's recently instituted stock machine program, the most popular types and sizes of Heald precision finishing machines are normally carried in factory stock at Worcester. Any time you can buy a *stock machine*, and supply your own fixtures and tooling, you get these important advantages . . .

1. **FAST DELIVERY.** Instead of waiting for several months for a specially built machine, your stock machine will be on its way in a matter of days or weeks.

2. **LOWER COST.** By eliminating special engineering and drafting, you get a top-quality basic machine at lowest possible cost.

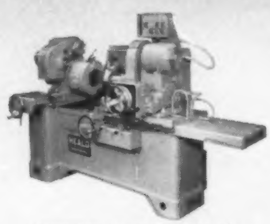
3. **UNLIMITED VERSATILITY.** Every Heald stock machine has the inherent versatility of speeds, feeds and cycling that permits easy adaptability to virtually any combination or sequence of operations.

If you need a standard machine in a *hurry* — and at minimum cost — it will pay you to check Heald on the availability of a *stock machine* that will meet your requirements.

THESE STANDARD HEALD MACHINES ARE NORMALLY CARRIED IN STOCK

BORE-MATICS

Model "0"
Model 121
Model 221
Model 321
Model 421
Model 222
Model 322
Model 422

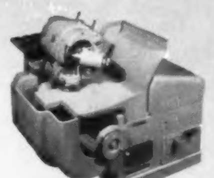


INTERNAL GRINDERS

Model 171 Size-Matic
Model 171 Gage-Matic
Model 271 Plain
Model 271 Size-Matic
Model 271 Gage-Matic
Model 271 Tool Room
Model 272 Basic
Model 273A Universal

ROTARY SURFACE GRINDERS

Model 161 6"
Model 261 16" Plain
Model 261 16" Automatic
Model 361 24" Plain
Model 361 24" Automatic



TOOL SHARPENING MACHINES

Model 3
Model 4

HEALD ®

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • New York • Syracuse

SEPTEMBER 1959

VOL. 66 No. 1

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Great Britain
MACHINERY
National House, West St., Brighton 1, England

France
LA MACHINE MODERNE
15, Rue Bleue, Paris-IX^e, France

BPA NBP

Machinery

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

SHOP PRACTICE

MACHINE AND TOOL DESIGN

MANAGEMENT PROBLEMS

REFERENCE SECTION

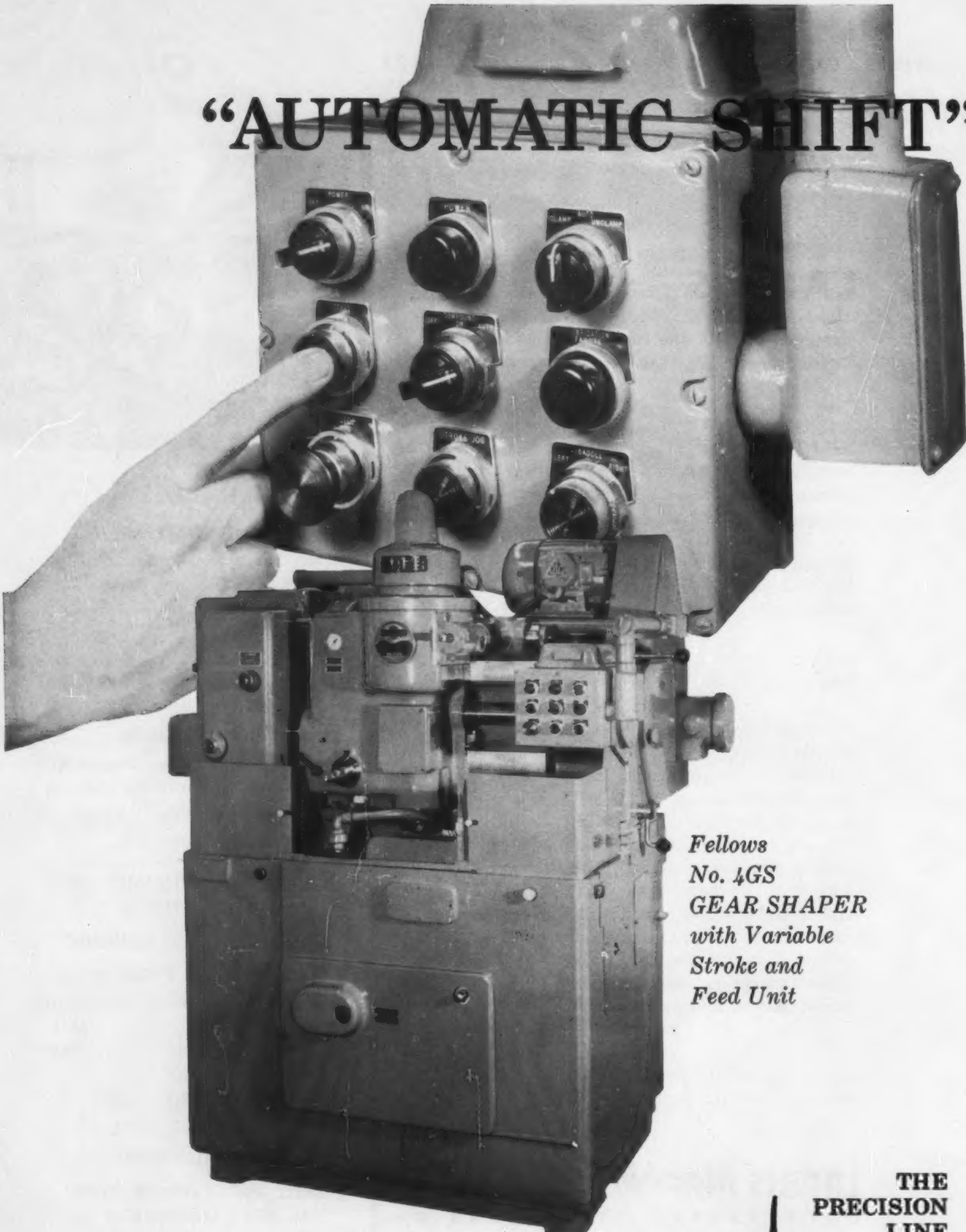
DEPARTMENTS

SOCIETY of BUSINESS MAGAZINE EDITORS

FROM THE WORLD'S LARGEST

A NEW LOW COST THREAD ROLLING MACHINE

"AUTOMATIC SHIFT"



Fellows No. 4GS GEAR SHAPER with Variable Stroke and Feed Unit

THE PRECISION LINE

changes Stroke and Feed

✓ Cuts production time...
✓ Lowers overall costs

Now . . . you can lower overall costs by using the Fellows No. 4GS Gear Shaper with the new, optional Variable Stroke and Feed Unit which *automatically* changes the rate of stroke and rotary feed between first and second cuts at any selected ratio within the speed and feed ranges of the machine.

With the Variable Stroke and Feed Unit the No. 4GS can make two cuts, and give you two-cut quality, in approximately the same time required for a single cut. There is no need to compromise on cutting speeds or feeds. Roughing and finishing cuts can be made at rates which are optimum for cutter and material.

Cutter wear is minimized, and finish is improved, because you can select and use the best combination of strokes per minute and feed per stroke of the cutter for each cut. Once the selector switches and gear ratios have been set, changes in speed and feed occur automatically during the cutting cycle.

The Variable Stroke and Feed Unit is available as an optional unit on all Fellows No. 4GS Gear Shapers. The selector switches for this unit can be set to operate the machine as a standard Gear Shaper; to change *either* the strokes per minute *or* the rotary feed for the finish cut; or, to change *both* stroke and feed for the finish cut.

The No. 4GS provides nine cutter speeds ranging from 98 to 635 strokes per minute and rotary feeds ranging from 0.008" to 0.028" per stroke, based on a 4-inch pitch diameter cutter. Set-ups are easy and fast for internal or external, spur or helical gears, as well as cams, splines and other non-involute shapes up to 6" pitch diameter and 2" face width.

For full information, get in touch with your nearest Fellows representative. If you would like to have a 72-page booklet describing the Fellows No. 4GS Gear Shaper and its operation, just write to any Fellows office.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont
Branch Offices: 1048 North Woodward Ave., Royal Oak, Michigan
150 West Pleasant Ave., Maywood, New Jersey
5835 West North Ave., Chicago 39, Illinois
6214 West Manchester Ave., Los Angeles 45

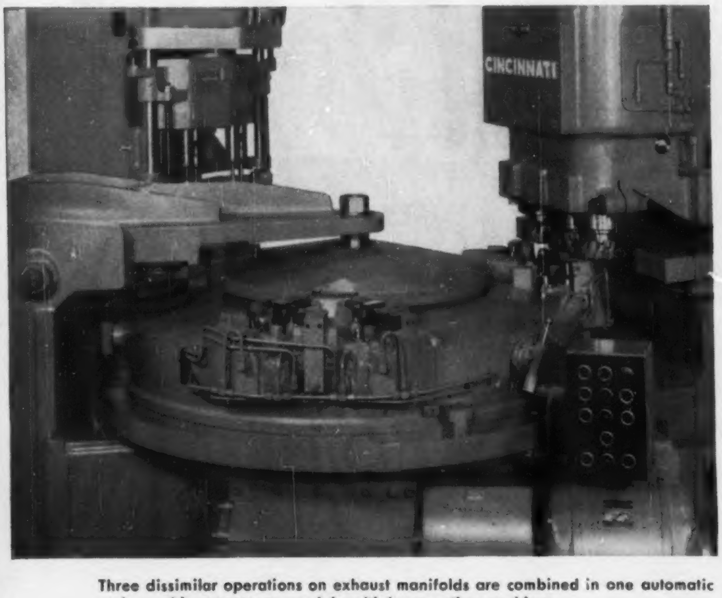
Fellows *Gear Production Equipment*

For more data, circle this page number on inquiry card

DEPENDABLE PRODUCTIVITY...

and Milling Line

and in Rotary Table Multiple Operation Machines



Three dissimilar operations on exhaust manifolds are combined in one automatic cycle on this CINCINNATI special multiple operation machine.

Part name	Exhaust manifold
Material	Cast iron
Operations	Mill joint face, drill 7 holes, broach joint face
Production	112 per hour, at 80% operator efficiency

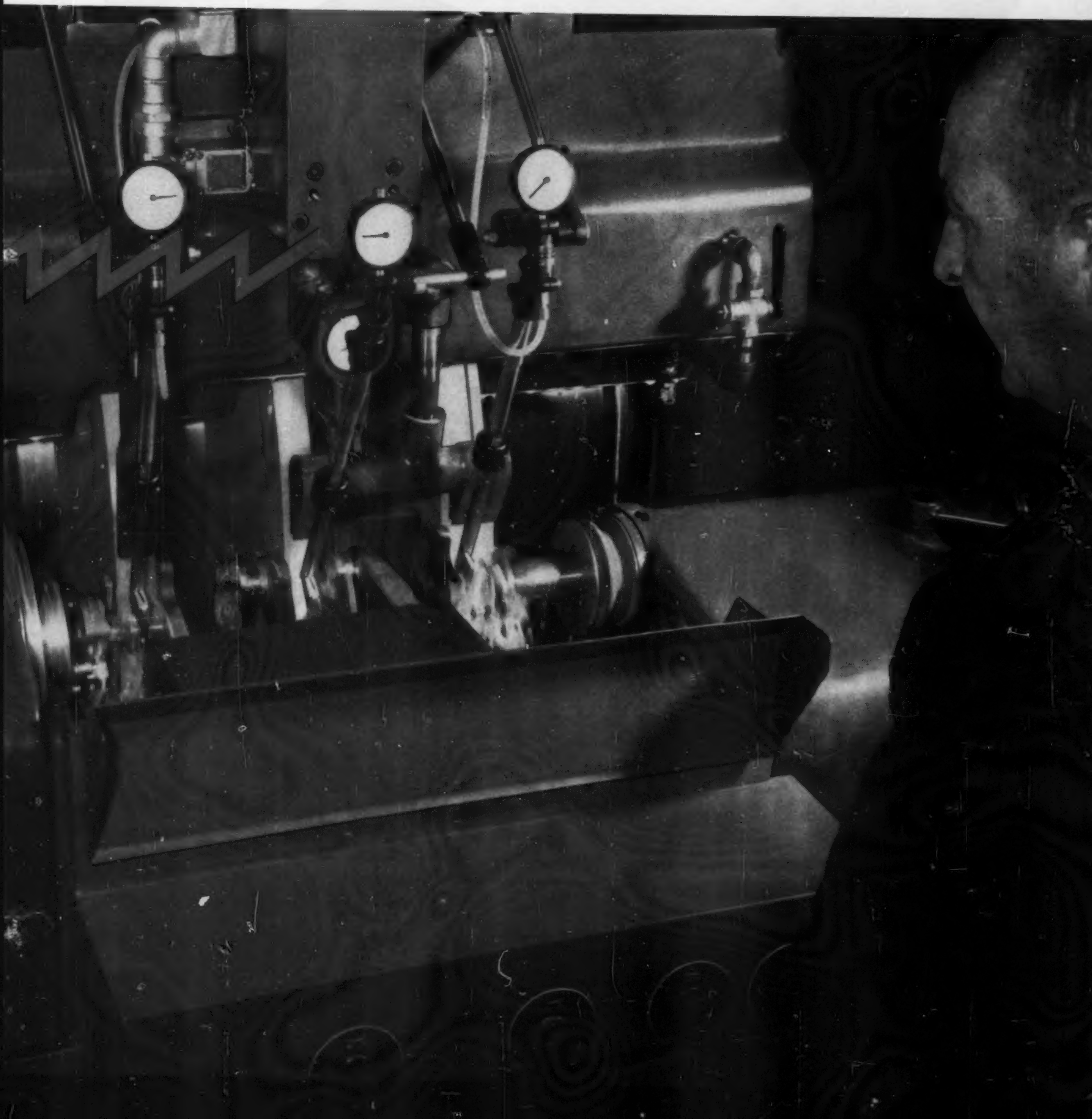
Production machines of this type have much in their favor: compactness; adaptability to changes in shop layout; push-button control; automatic cycling. The Cincinnati Special Machine Division incorporated all these advantages, plus a high degree of *dependable productivity,* in the multiple operation Rotary Table Machine at the left. It mills, drills and broaches exhaust manifolds in one automatic cycle.

A wide range of companies in many industries throughout the country have improved their operating performance and the quality of their products through the assistance of the Cincinnati Special Machine Division. Perhaps you too can find a solution to *your* cost-of-production problems, through our Engineering Service Specialists and our facilities for building cost-reducing equipment of any size.

...ACHINES • COMPLETELY AUTOMATED PRODUCTION LINES

CINCINNATI®
SPECIAL MACHINE DIVISION

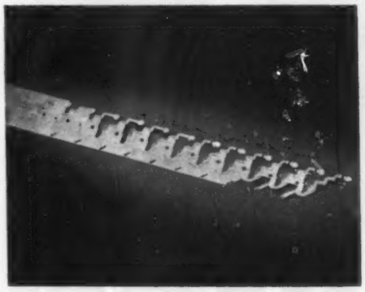
feed

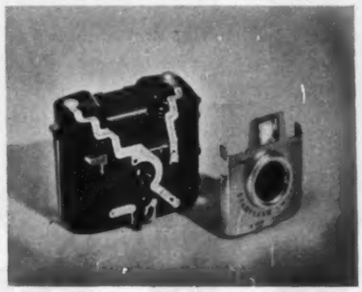


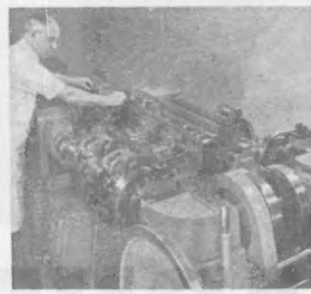
U.S. MULTI-SLIDE® CONTRIBUTES TO SUCCESS OF KODAK BROWNIE STARFLASH!

Manufacture of a reliable, practical camera, with a built-in flash, that will sell at a popular price calls for considerable engineering skill and technical know-how. It calls for good design and sturdy construction. It demands consistently accurate production — unwavering accuracy at high speeds.

Eastman Kodak Company has been using U.S. Multi-Slide Machines for many years and has found them satisfactory in high volume production of irregularly shaped parts. Parts are manufactured without intermediate handling or secondary operations that would have been required by conventional methods.







Presently, Eastman Kodak Company's Apparatus & Optical Division uses U.S. Multi-Slides for the production of no less than six parts for Brownie Star Cameras; the Starflash, Starflex and Starlet.

A Model #33 U.S. Multi-Slide is used to produce battery connectors for the Brownie Starflash. The machine is arranged with multiple rams and tooling with three separate die stages — producing a completed part at each cycle.

Because of their versatility, the U.S. Multi-Slides could be readily adapted by Eastman Kodak's A. & O. Division to manufacture future flat stock stampings, wire parts, or the simultaneous feeding and processing of more than one strip to complete an assembly. Prefabricated parts could be hoppered, positioned and assembled to the stamping being made in the machine.

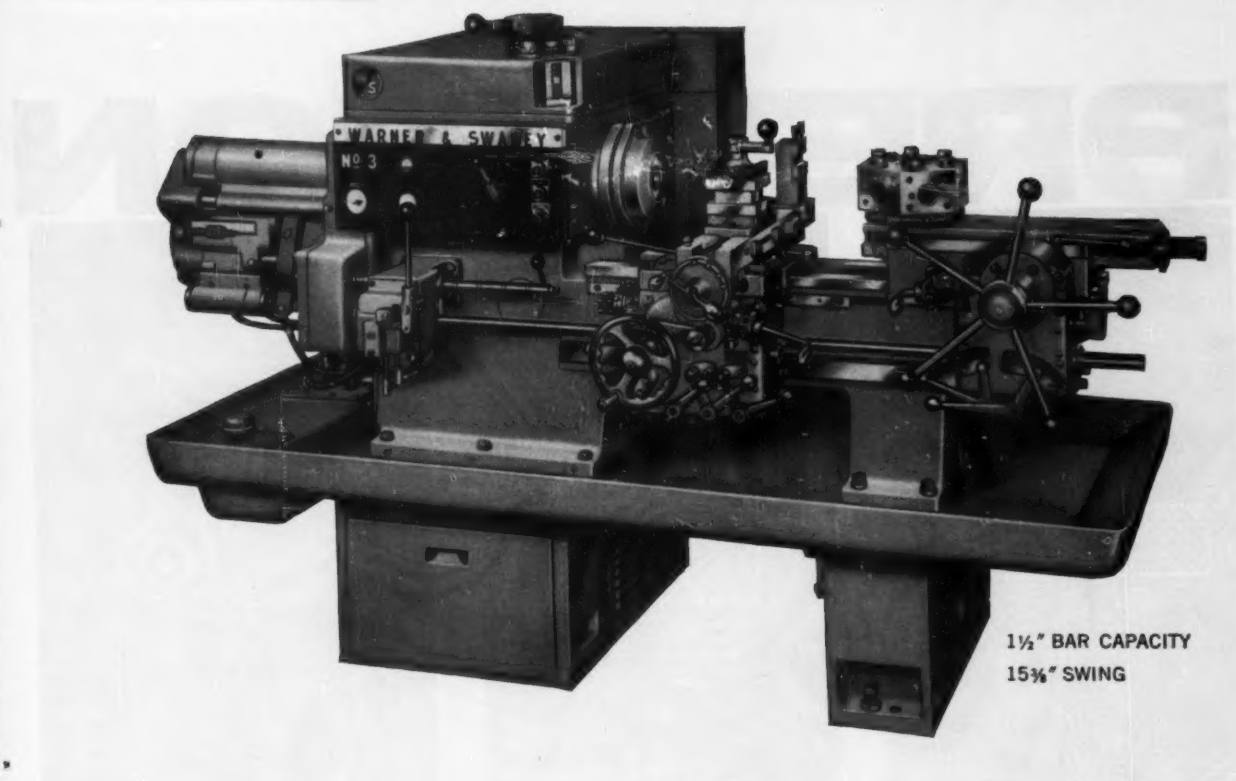
Write today to find out how U.S. Multi-Slides can produce your stamped components better and more efficiently . . . ask for Bulletin #15M, or send in samples or drawings of the part you want produced.

ILLUSTRATED OPPOSITE PAGE: The popular Kodak Brownie Starflash Camera . . . ABOVE: Left to right: Successive stages in the production of Brownie Starflash Battery Connectors as stamped by a U.S. Model #33 Multi-Slide . . . Brownie Starflash Camera disassembled (built-in flash removed) to show location of battery connector produced on a #33 U.S. Multi-Slide, part of flash synchronization circuitry . . . U.S. Multi-Slide Model #33 in use at Eastman Kodak Company's Apparatus & Optical Division in Rochester, New York. Machine is turning out battery connectors for the Brownie Starflash Camera.

U. S. TOOL COMPANY, INC. AMPERE (East Orange) NEW JERSEY

U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories

US MULTI-SLIDE



No.3 ram type turret lathe

This is how easy it is to operate

Exclusive, Single Lever Preselector and Speed Control

Control of spindle speeds is now an easy one-hand operation on the new No. 3! Preselection of speeds, speed change, brake and neutral—all are obtained with the same lever!

No fumbling for speeds... no gear shifting. Just rotate the handle to preselect; move it up or down to engage new speed instantly.

No figuring... the direct reading preselector dial tells you the surface speed for each diameter and rpm.

No remembering (or forgetting)... the preselector drum lets you set up the sequence of cuts; numbered clips tell you where to find the speeds and their order of use.

Neutral (free spindle) and Brake are selected by rotating lever to the left.

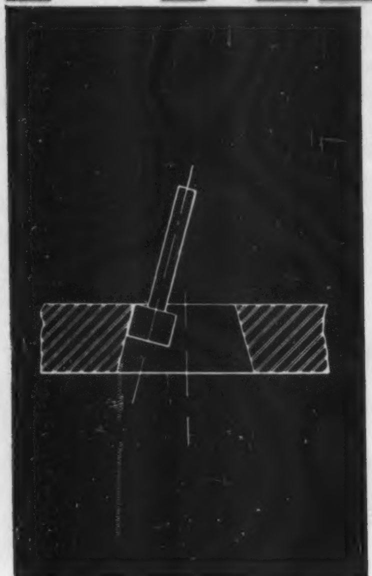
Forward and Reverse are controlled by a switch lever on front of headstock.

For free brochure write Warner & Swasey Company, Cleveland 3, Ohio.

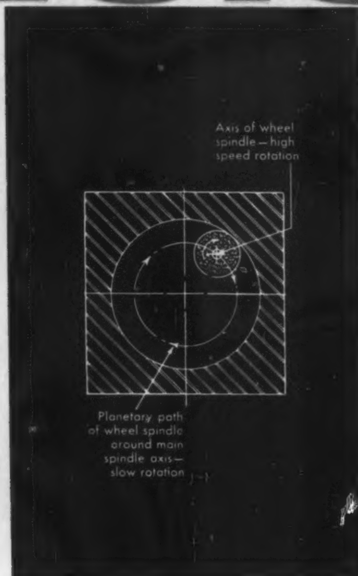
You can produce it better, faster, for less... with a WARNER & SWASEY

W/S

PRECISION



TAPER
(and straight)



PLANETARY

CONTOUR
(with head)

MOORE-FOSDICK JIG GRINDER

A new degree of speed, convenience and capacity is brought to precision grinding in the Moore-Fosdick Jig Grinders. This combination of the unique Moore Grinding Head with Fosdick Jig Borer Tables makes possible advantages never before available.

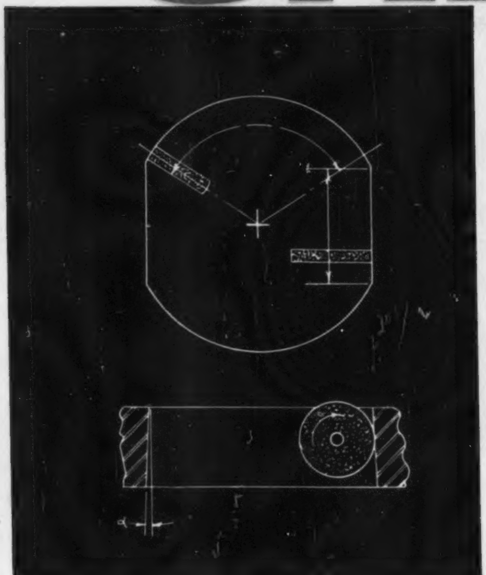
All standard jig grinding operations can speedily and conveniently be accomplished on the Moore-Fosdick, in addition to many which were formerly known as "trick" operations. Both straight and tapered holes can be located and ground, as well as contours consisting of radii and tangents or chordal surfaces.

The angular and indexing device built into the main spindle and the slot grinding attachment permit quick, accurate grinding of any contour, regular or irregular. Setting work on a rotary table is unnecessary except for angular surfaces. Chop grinding removes stock rapidly and makes contour grinding even faster.

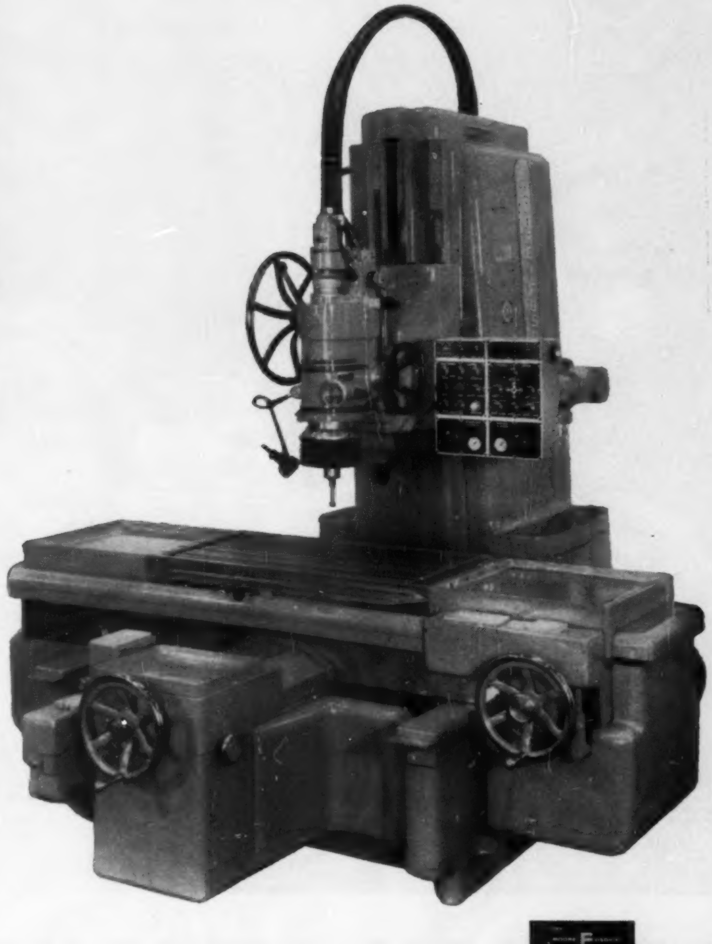
An infinite range of grinding speeds—from 12,000 to 60,000 rpm—allows accurate control

GRINDING

OF LARGE WORK



CONTOUR
(with slot grinder)



of grinding and stock removal. Long-lasting precision is assured by quality construction and by many features that provide dimensional stability, including spindle-housing heat control.

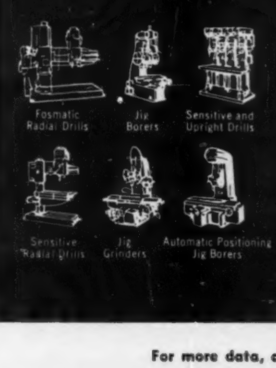
The machine may be ordered in any one of three models, one of which comes in two sizes. *All will give accuracy of ± .0001".*

Measuring is accomplished with measuring rods and inside micrometers or with Direct Dimension Measuring, where dimensions are simply set from blueprint to direct reading drum dials. Automatic positioning is also available.

Numerical control by punched tape or cards is available.

For a complete description of the various grinding operations, measuring systems and other machine features—many exclusive with Moore-Fosdick, write today for your jig grinder catalog.

Ask for Bulletin JG-M

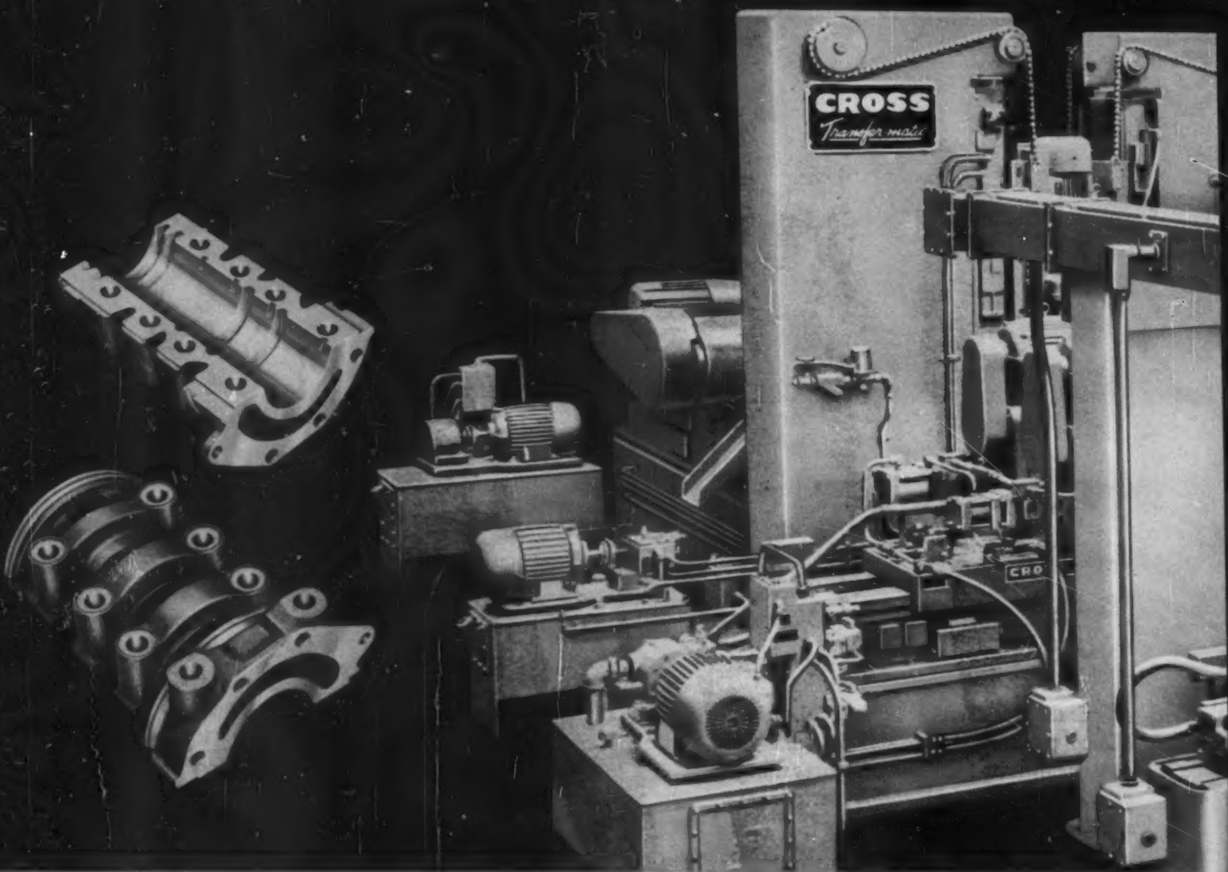


NEED DRILLING EQUIPMENT? GET A PROPOSAL FROM FOSDICK!

FOSDICK

THE FOSDICK MACHINE TOOL CO.
CINCINNATI 23, OHIO

A New Approach For Processing Crankshaft Bearing Caps



This Cross Transfer-Matic, built for an European automotive company, provides an entirely new approach to machining crankshaft bearing caps. Capacity of the 30 station machine is 109 sets (436 pieces) per hour at 100% efficiency.

The parts, cast in clusters of four, are breached in preparation for the operations performed by the Transfer-Matic. Unlike American designs, the No. 1 and 4 caps require felt seal grooves and the No. 1 cap has a pattern of four holes in the end for mounting a fan belt cover.

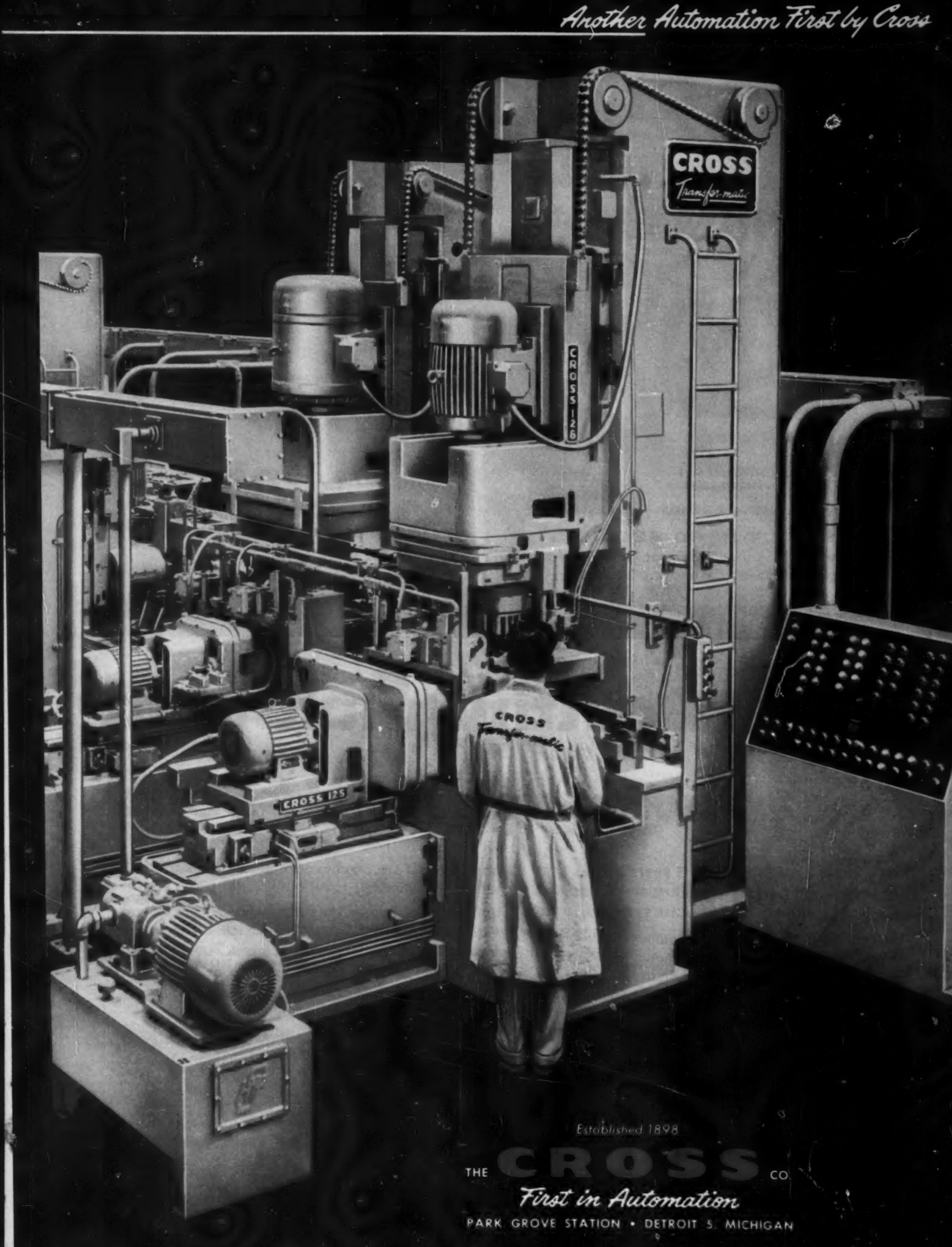
New Methods

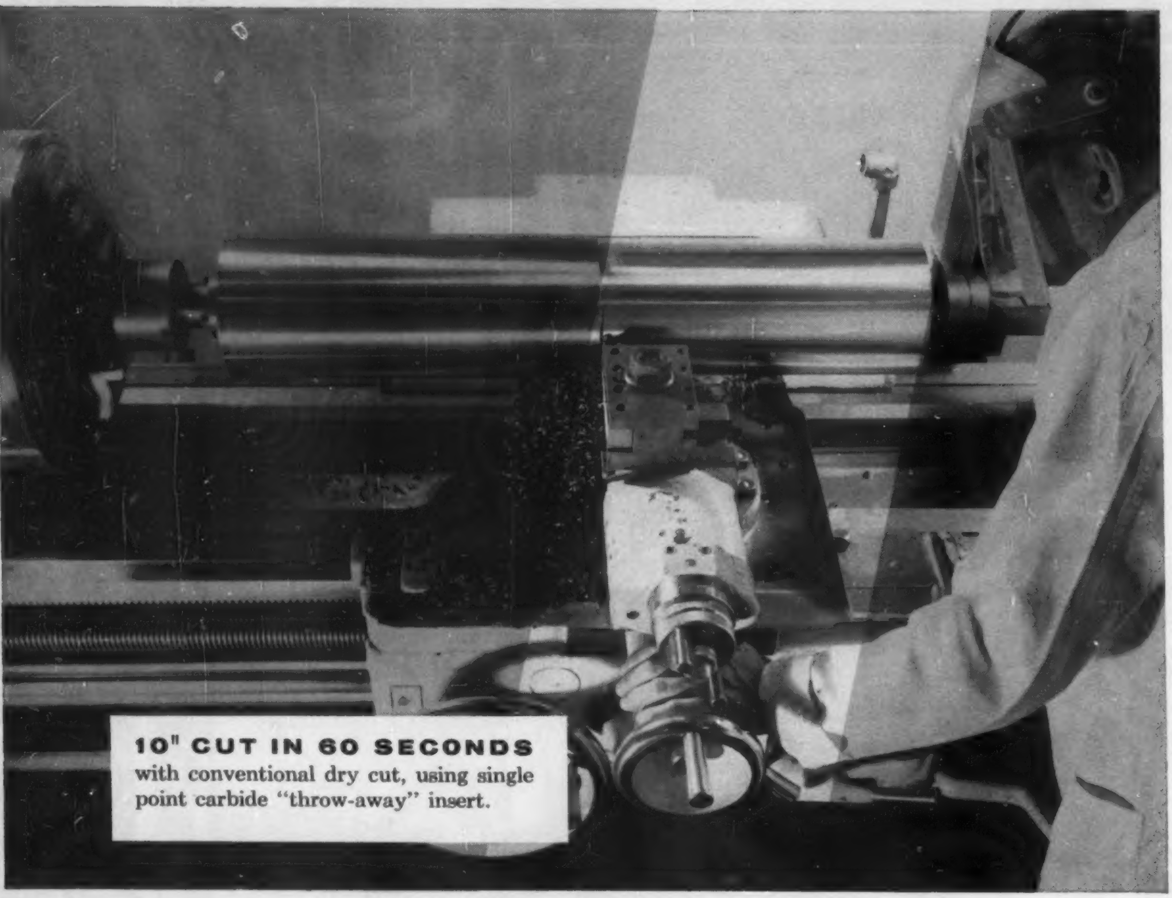
The clusters are indexed by a lift and carry transfer mechanism with the crankshaft axis at right angles to the transfer movement. The felt seal grooves are machined by standard cross-facing heads mounted on horizontal positioning units. The fan belt cover hole operations are also performed horizontally. The bolt holes, bearing lock notches, oil slinger grooves and the milling of a lug on the No. 1 bearing cap are all machined vertically.

New Sawing Unit and Fixture

At the very end of the machine, the clusters are shuttled into a special sawing fixture where they are cut into individual pieces and ejected. The fixture, a new design, holds the parts with the joint face at a 40° angle. This arrangement permits the chips to fall free of the clamping mechanism and substantially reduces the overhang of the sawing cutters. During the sawing operation, locating pins are inserted in all of the bearing cap bolt holes to provide maximum rigidity and to prevent pinching of the saws as they withdraw from the work.

The machine is constructed to JIC Standards, has complete interchangeability of all standard and special parts, and is constructed out of standard Cross building blocks for optimum flexibility. A Cross Machine Control Unit equipped with Toolometers programs tool changes to reduce machine downtime. All tools are pre-set in standard Cross tool setting fixtures.


Another Automation First by Cross
CROSS
Transfer-matic
CROSS 126
CROSS 125
Established 1898
THE CROSS CO.
First in Automation
PARK GROVE STATION • DETROIT 5, MICHIGAN



A new cutting fluid that

with any single-point

Shell's experience in the last 3 years proves that Shell Dromus Oil E can give production increases of at least 25% with comparable cost savings.

Incredible as this may seem, Dromus® Oil E alone accounts for these considerable production increases! And here's how simply Dromus E does it: Use Dromus Oil E (diluted with 20 parts water) at the correct cutting speed. Then, increase the feed rate by one-third and operate as before. You can get a 25% production increase . . . optimum conditions may show as high as 40% improvement!

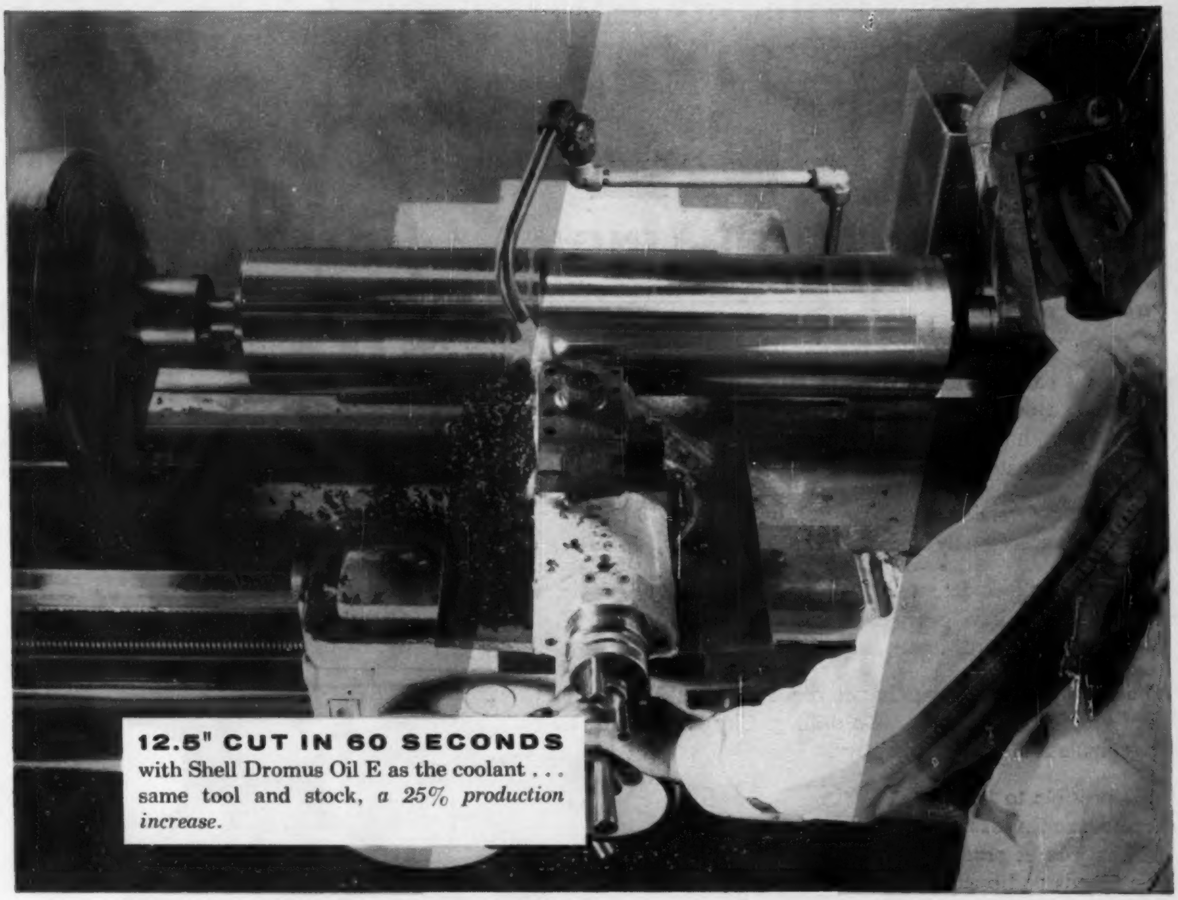
Applies to wet or dry cutting. Regardless of whether you're now cutting dry, or with emulsions or heavy-duty oils, this simple increase of feed applies.

Applies to all milling, turret and automatic lathe set-ups. This is an across-the-board production improvement. If the machine can stand the extra 25% feed, the rule applies to all milling and turning jobs!

Applies to set-ups as they are . . . no changes required. There isn't a single thing that has to be changed or adjusted . . . just the feed and provision for keeping the work wet with Dromus E.

Shell Dromus Oil E offers these many other outstanding benefits too!

1. Greater worker safety—chips are cool.
2. No fire hazard—Dromus E is nonflammable even after water evaporation.
3. Closer dimensional tolerances can be obtained—less heating of the work piece occurs.
4. Brighter surface finish is obtained.
5. Excellent protection against rust.



permits 25% greater feed

(AT FULL SURFACE SPEED)

carbide "throw-away" insert

Dromus Oil E is one of those products that comes up once in a generation. Rather than attempt to offer proof after proof of what this announcement offers, we simply invite you to let the Shell Industrial Products Representative show you what Dromus Oil E can do in *your* plant! Please write Shell Oil Company, 50 West 50th Street, New York 20, New York, or 100 Bush Street, San Francisco 6, California. In Canada: Shell Oil Company of Canada, Limited, 505 University Avenue, Toronto 2, Ontario.

SHELL DROMUS OIL E

THE NEW COOLANT FOR METALWORKING

SHELL

NOW

"COLD-POINT" DRILLING!

of Super-Hard Metals, Glass or Ceramics with "Buffalo" Hollow Spindle Drill. Speeds to 10,000 RPM!

Now you can buy a production drilling machine especially designed to deliver the high speeds and forced coolant flow necessary with the new hollow core cold-point drill, and diamond impregnated bits.

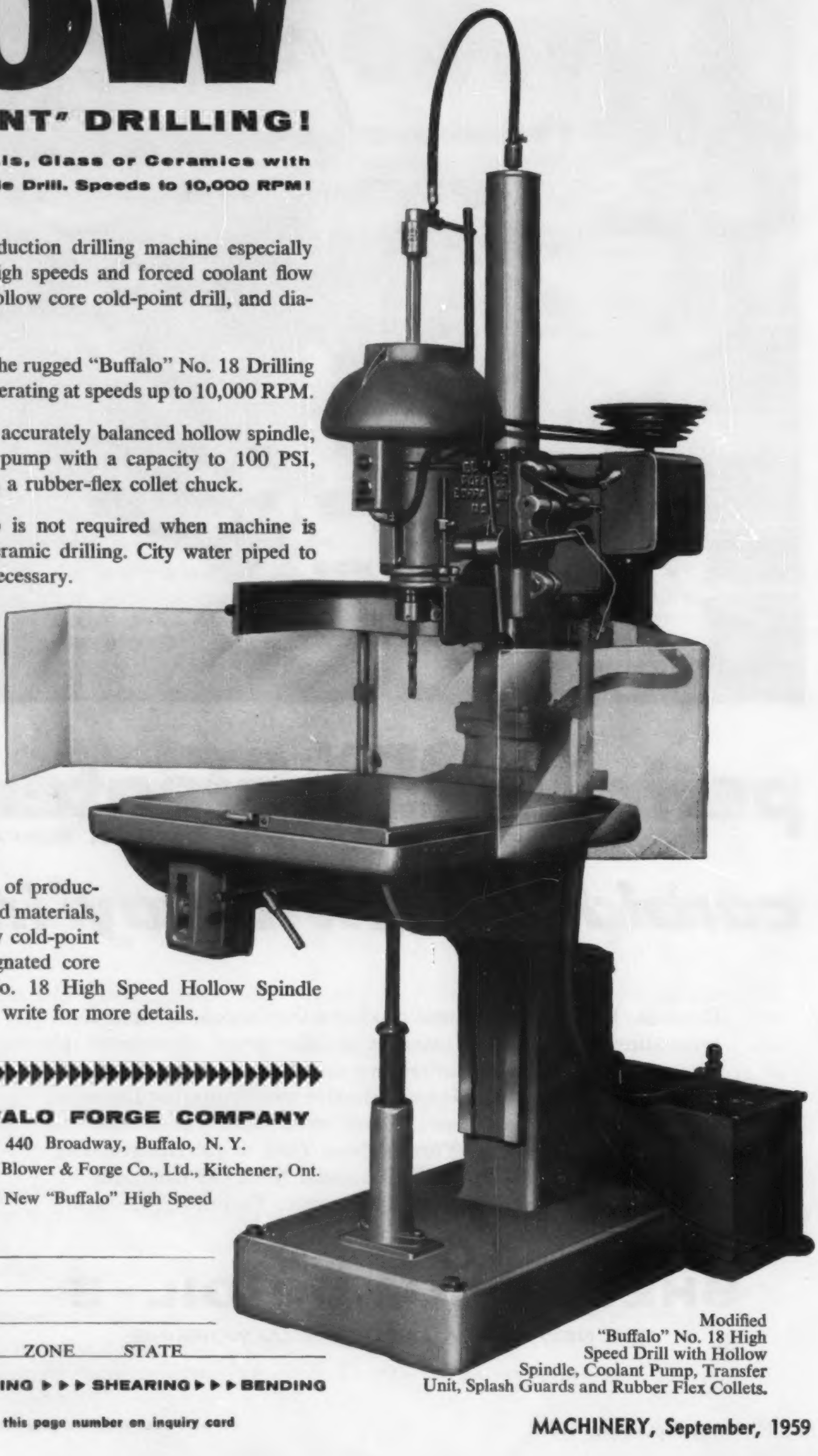
This modified version of the rugged "Buffalo" No. 18 Drilling Machine is successfully operating at speeds up to 10,000 RPM.

Modifications include: an accurately balanced hollow spindle, coolant system having a pump with a capacity to 100 PSI, special splash guards and a rubber-flex collet chuck.

The high pressure pump is not required when machine is used only for glass or ceramic drilling. City water piped to the spindle is all that is necessary.

It is possible to handle heretofore impossible drilling jobs at production speeds and regular drilling can be done much faster. In many cases reaming or finishing can be eliminated because of the fine quality of the drilled hole.

If you have the problem of producing holes in extremely hard materials, you need the new hollow cold-point drill or diamond impregnated core bits and a "Buffalo" No. 18 High Speed Hollow Spindle Drill. Use the coupon or write for more details.



Modified "Buffalo" No. 18 High Speed Drill with Hollow Spindle, Coolant Pump, Transfer Unit, Splash Guards and Rubber Flex Collets.

BUFFALO FORGE COMPANY

440 Broadway, Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Please send me details on New "Buffalo" High Speed Drilling Machine:

NAME____________________

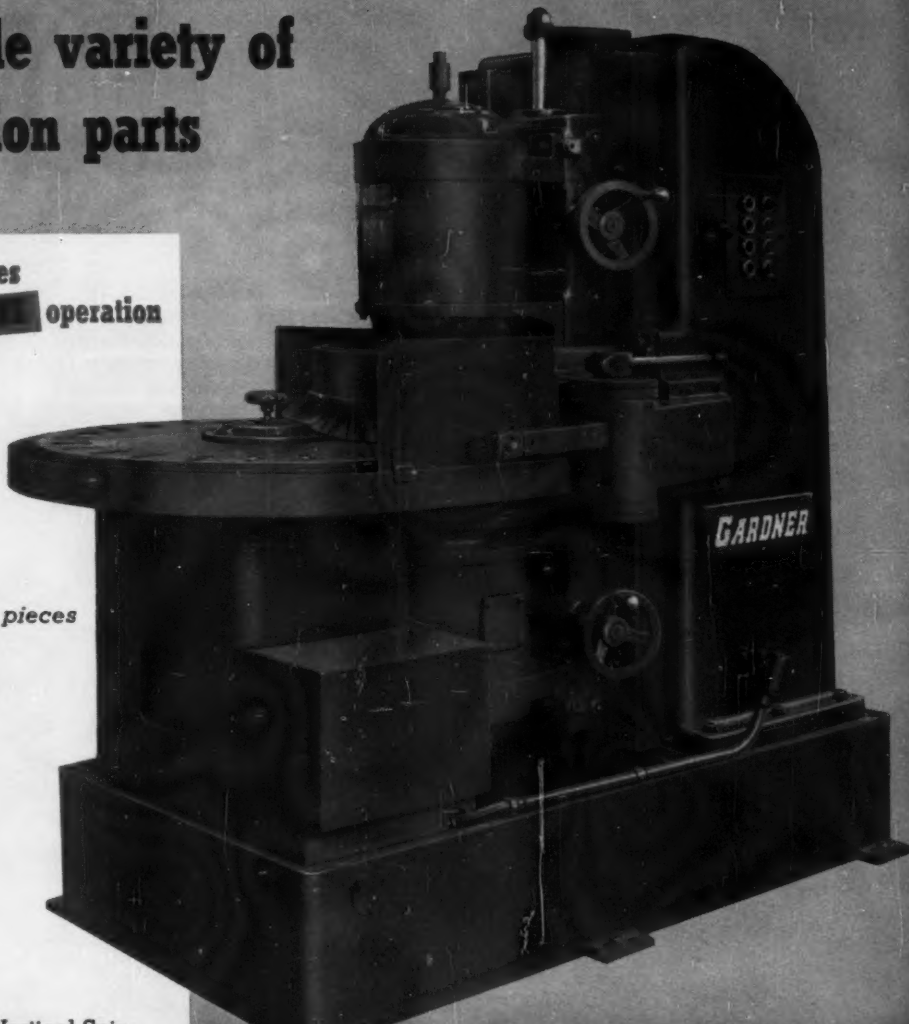
COMPANY____________________

STREET ADDRESS____________________

CITY__________ZONE_____STATE__________

DRILLING ▸▸▸ PUNCHING ▸▸▸ SHEARING ▸▸▸ BENDING

Gardner 2V18 demonstrates versatility in grinding wide variety of small precision parts

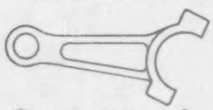


[redacted] parallel surfaces precision ground in [redacted] operation

Counter pinion
2400 per hour

Upper and lower pole pieces
250 per hour

Watch disc
4000 per hour



Connecting rod
900 per hour

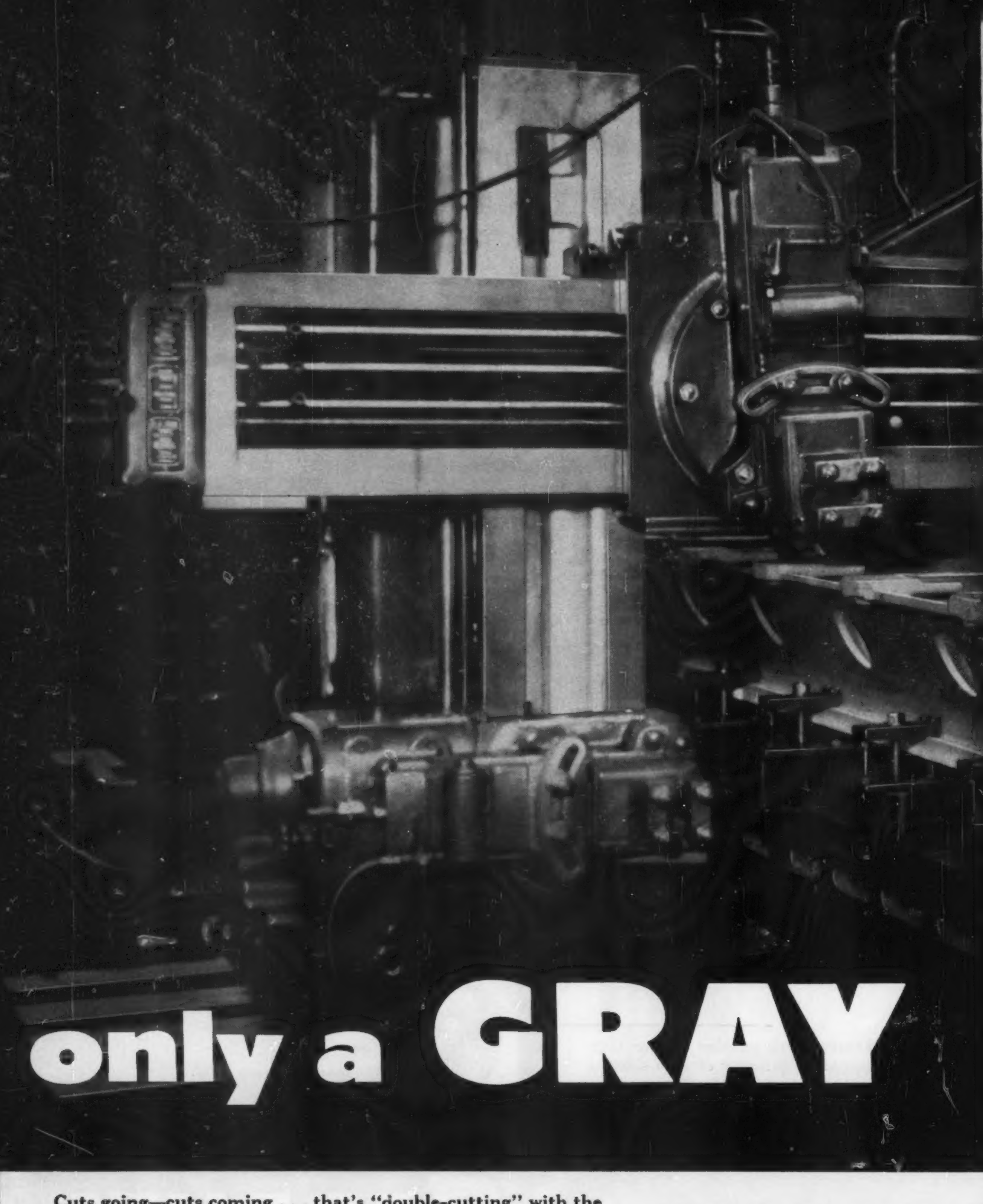
Gardner 2V18 Double Vertical Spindle Grinders lower costs with fast, accurate grinding. Interchangeable work carriers for parts of many shapes, assure profitable, flexible operation. Write for latest catalog.

Rotary work carrier assures high production grinding of both sides of small connecting rods.

GARDNER

precision disc grinders

BELOIT, WISCONSIN



Cuts going—cuts coming . . . that's "double-cutting" with the GRAY Universal Planer. At Textile Machine Works, Reading, Pennsylvania, this new GRAY is pictured double-cut carbide planing a Tricot Machine Base. Former floor to floor time of 62 hours has been slashed to 12 hours by the enormous productive potential of the new GRAY that cuts both ways.

The G. A. GRAY Co., Cincinnati, Ohio.

heavy-duty planing

The Gray Universal is the world's most powerful planer available for conventional planing. Its rigidity and speed are ideally suited for modern carbide cutting.

Bertsch & Co. finds solution to lubrication problem—

RYKON

Centralized lube system pumps grease through 80 ft. lines in cold temperature; no clogging

Problem: Bertsch & Company, Cambridge City, Indiana, makes pinch rolls and other metal bending equipment. Some Bertsch pinch rolls bend plates 4¼ inches thick by 16 feet wide for use in atomic submarines. Bearings on this big Bertsch machine share a bending pressure of 4.2 million pounds. A centralized lubrication system used on one pinch roll model had to pump grease 80 feet. Greases tried could not be pumped this distance without clogging lines. Since machines are shipped all over the world and are often in operation in cold climates, Bertsch had additional problems. The grease had to be

Sons of founder. Harry E. and Robert O. Bertsch talk with Standard Oil lubrication specialist Donald M. Simmons. Don is well qualified to work with customers on difficult lubrication problems. He has the training and experience for it. Don graduated from Purdue. He has 7 years service with Standard, has completed the Standard Oil Sales Engineering School.

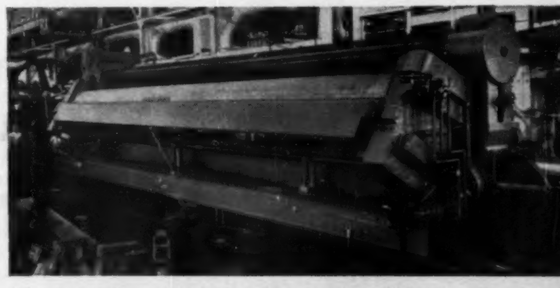
with Standard Oil's

Grease R

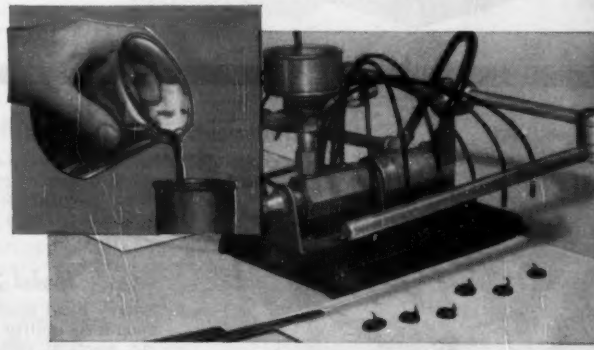
pumpable in cold temperatures. It had to be foolproof so that customers beyond the reach of service calls would experience no problems. Equipment had to uphold Bertsch's eighty year reputation.

What was done: Bertsch turned to Standard Oil for help. They have been customers of Standard's for 69 years, so the move was logical. And Standard Oil man, D. M. Simmons had the answer. RYKON Grease R. This is a rheopectic grease, one that flows like an oil. Its rheopectic properties cause it, under slight shearing stresses, to turn to a thick, durable grease. RYKON Grease R flows as a fluid to the pump through the equipment's central lubrication system. There it lubricates the bearings as a grease.

What you can do: Maybe you manufacture equipment that needs a centralized lubrication system and you have been looking for a grease like RYKON R. Maybe you operate equipment with centralized lubrication systems. Then you need to know about RYKON Grease R. Get the facts from your nearby Standard Oil lubrication specialist anywhere in the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**



A Bertsch 80 ft. pinch roll, largest on record. RYKON Grease R is used in the central lubrication system of this giant unit.



Lab demonstration shows how RYKON Grease R works. Grease is poured into reservoir as a fluid. The shearing action exerted by pump and outlets irreversably converts fluid to a grease. Grease is ejected from outlet lines as in lubrication system.

STANDARD

You expect more from Standard and you get it!

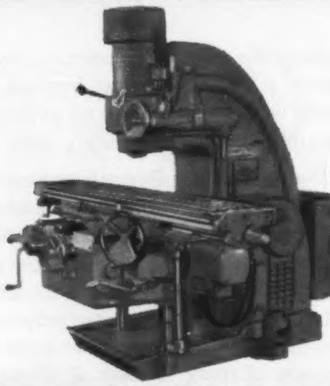
For more data, circle this page number on inquiry card

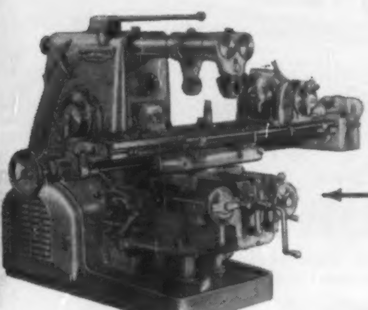
Kearney & Trecker machine tools

quality...greater economy and

TF Series Line

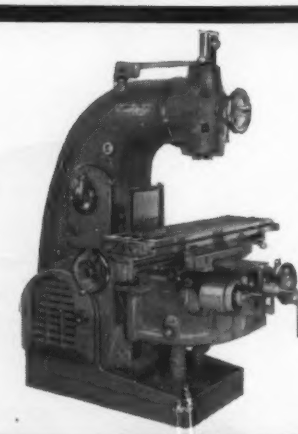
Strikingly new milling machines feature twin screw knee support for greater rigidity; new control center for ease of operation; improved Mono-Lever and Automatic Cycle Table Control; front-mounted backlash eliminator; adjustable saddle clamping gib; three bearing spindle that increases rigidity eight times over spindles without center bearing support, and many other features. TF's are available in five sizes Plain (left), Universal and Vertical (right) styles from 10hp to 50hp. (Catalog No. TF-50)

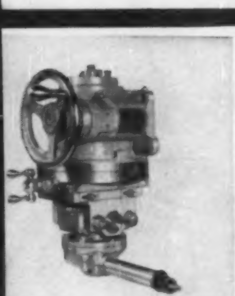




CH & CHL Milling Machines

These modern knee type milling machines incorporate the latest design and operating features... greater capacity for power, speeds and feeds. Machines are available in Plain, Universal and Vertical styles.. 3 to 10hp. (Catalog No. CH-3)



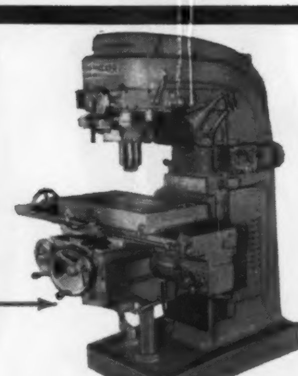


Attachments and Accessories

A complete selection for every milling requirement to convert standard machines into special purpose tools. Provide maximum productivity by supplementing with any of the various Kearney & Trecker standard attachments. Bulletins available on request.

Model 2D Rotary Head

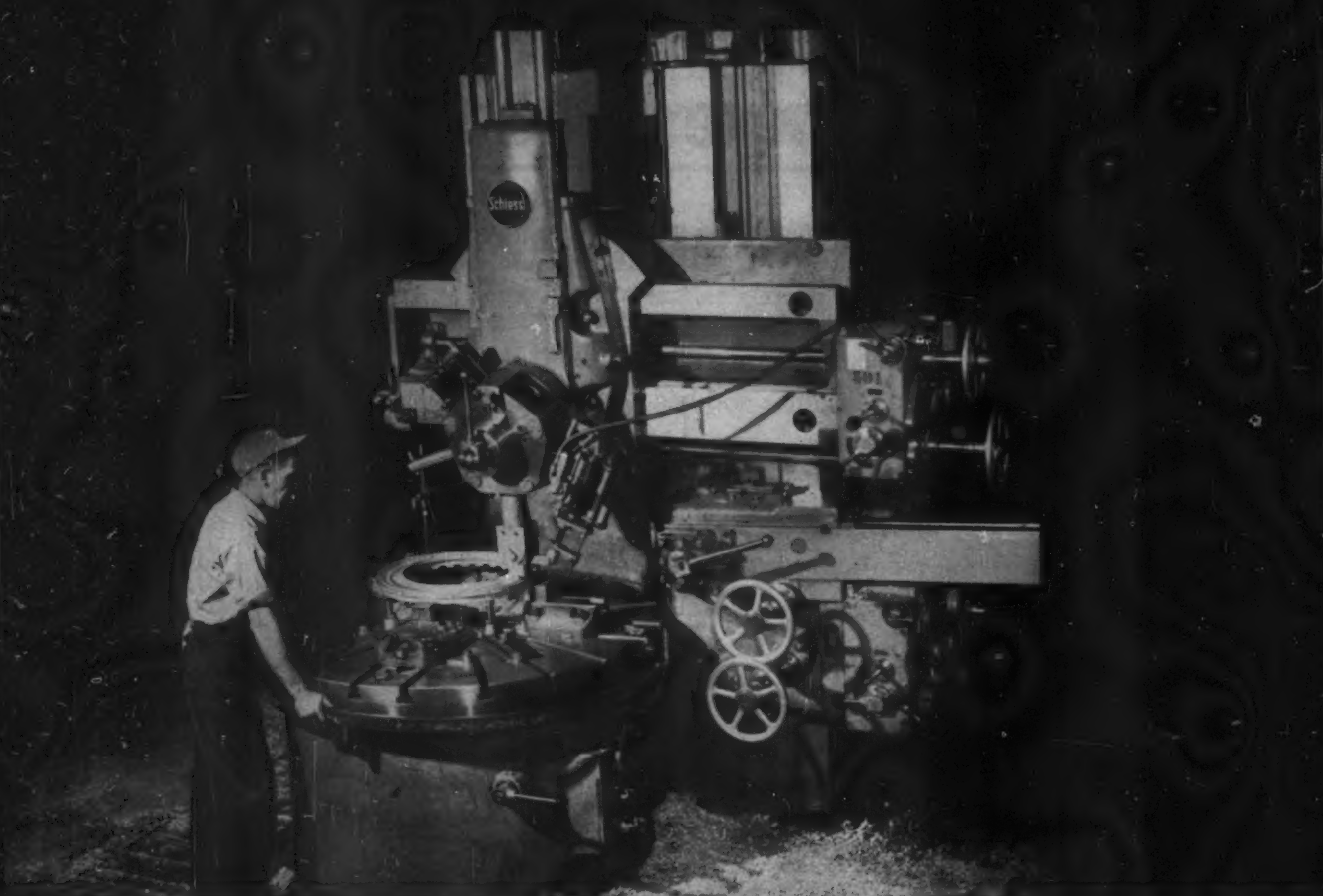
Rotary head motion, combined with milling machine's ability to do boring, slotting, drilling, vertical milling, circular and angular milling, transmits complete blueprint into metal without changing setup. Speed range 250 to 4000 rpm; feed range .0002 to .008 ipr; rotary head feed range (16 changes) 2 to 3 rpm. (Catalog No. D-20)

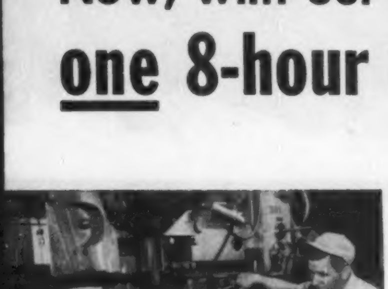


TOOL-LEASE

Should you desire, you can conserve capital, reduce obsolescence using Kearney & Trecker's Tool Lease program. You can choose the machines you need from nearly 350 different standard milling and precision boring machines.

Designers and Builders of Precision and Production






SIEGEN
WALDRICH
SIEGEN

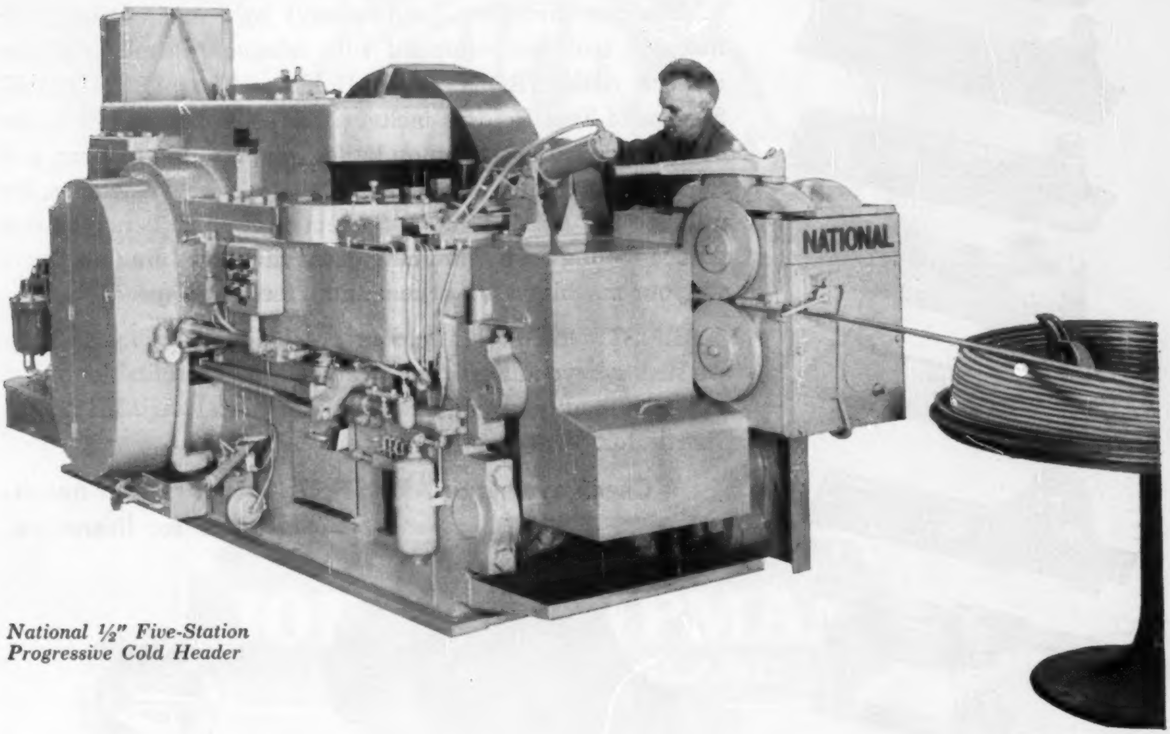
Top row, left to right: piston pin, wheel nut, ball stud, pump shaft, faucet stem.
Middle row: spark plug body, eye bolt, shuttle tip, ball socket, universal joint bearing cup, splined square-head shaft.
Bottom row: tube nut, tappet plunger, hollow rivet, blind rivet, distributor cap insert, commutator bar.

These are typical parts you can make to advantage, not by wasteful cutting, but by *cold heading* — flowing metal into accurate shapes. All of the above jobs, with one exception, were made complete from coiled wire to finished part, without intermediate annealing and coating, *in one compact machine!*

Why are formerly difficult-to-head jobs like these not only possible now, but commercial? The answer is teamwork, on many fronts. For example:

(1) More versatile metals are now available in coiled wire. (2) Die materials and lubricants are still better. (3) We are getting important (to us) but usually insignificant concessions from cold-heading-minded parts designers. (4) National Cold Headers, multiple-die Progressive Headers, Cold Formers

The modern way to make Metal Parts faster, stronger, to amazingly close dimensions!



National ½" Five-Station Progressive Cold Header

and Boltmakers, backed by our fast-growing engineering experience, are now specially equipped to produce reliably the formerly difficult jobs like these shown here.

Are your production problems like these? Perhaps cold heading could pay off for you in a remarkably short time. Let's find out.

Here is our service to metalworking, and you are under no obligation to buy. Send us samples or prints of your jobs. Better yet, bring them to Tiffin where more of our experienced people can participate in *your* problem.

We shall be happy to work with you in developing that better method.

Founded 1874—DESIGNERS and BUILDERS of MODERN FORGING MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS CO-PIONEERS WITH INDUSTRY OF ADVANCED METALWORKING PRODUCTION METHODS

NATIONAL MACHINERY CO.

TIFFIN, OHIO, U. S. A.

HARTFORD **DETROIT** **CHICAGO**

ARMSTRONG

TOOL HOLDERS

A Correct Tool for Every Lathe Operation

You can save time (and money) by ensuring that your machine tools are equipped with *adequate numbers* of the correct ARMSTRONG Tool Holders. The ARMSTRONG System of Tool Holders includes correctly designed tools for *every* standard operation on lathes, shapers, and planers, and for many operations on turret lathes and screw machines. By utilizing the ARMSTRONG System of Tool Holders, you can reduce tooling costs, eliminate down time in tooling up, operate your machine tools at maximum feeds and speeds.

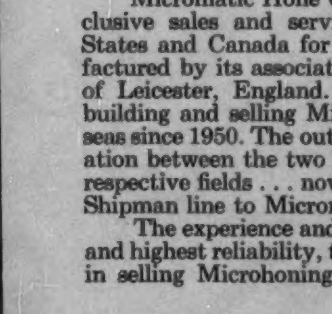
ARMSTRONG Tool Holders are long-lasting tools. They are strong beyond need, handy and efficient, profitable to use, and are readily available from your local ARMSTRONG Distributor.

Check over your ARMSTRONG Tool Holder needs. Write for literature.

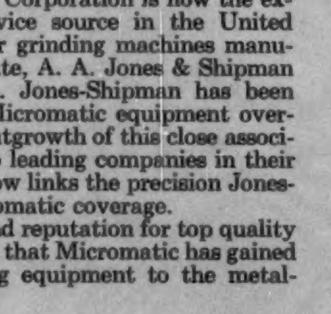
INDUSTRIAL DISTRIBUTORS — THE RIGHT HAND OF PRODUCTION

If you do not know the name of your local ARMSTRONG Distributor, inquire when asking for literature.

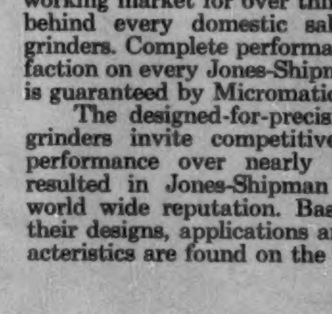
ARMSTRONG BROS. TOOL CO. 5213 W. ARMSTRONG AVE. CHICAGO 46, ILL.



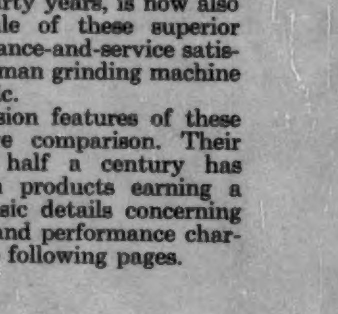
MODEL 1014
Universal Toolroom Grinder



MODEL 540
Hydraulic Surface Grinder



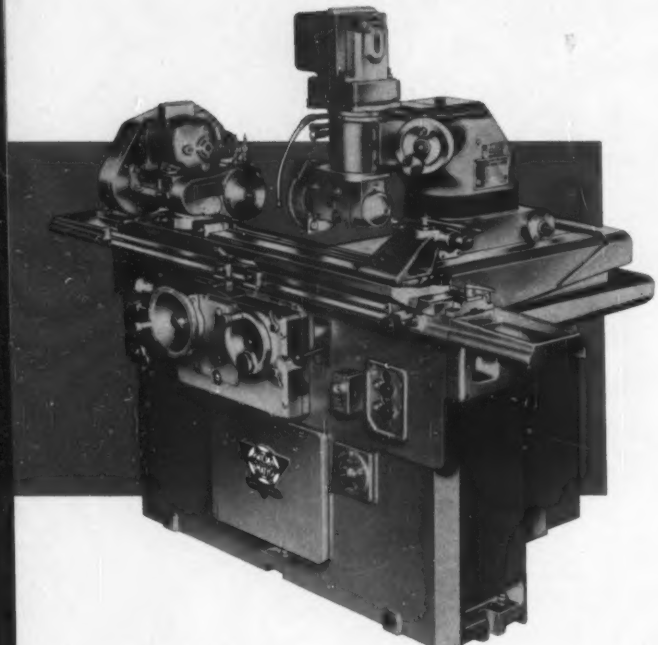
MODEL 1305
Precision Grinder



MODEL 310
Cutter and Tool Grinder

HERE ARE GRINDERS THAT

for Precision, Durability, Range of



MODEL 1014
UNIVERSAL TOOLROOM GRINDER

This 1014 Universal Tool Room Grinder is designed to give extra-ordinary sensitive control that results in *high quality external and internal grinding.*

Wheelhead is of a special type. It has deep throat capacity and wheel position is centralized in relation to table. This permits surface grinding (using hand cross-transverse) and offers special facilities for broach grinding.

The extra Universal Cutterhead extends the versatility of this highly accurate machine to cover tool and cutter grinding.

FEATURES:

Hand cross-feed and vertical-feed in .0001″ increments • Automatic cross-feed per reversal of table of .0001″ to .007″ over .025″ (reduction in work diameter of .050″). • Automatic table traverse, 4 speeds provided. Micrometer adjustment to table traverse in .001″ divisions. • Wheelhead saddle on anti-friction mountings. Long vertical roller slides provide complete support of wheelhead in all positions. • Precision built wheelhead motor on anti-vibration mountings. • Wheel spindle unit swivels full 360°. Five external grinding wheel speeds. • Grinding wheels fitted on either end of wheel spindle. Nitralloy spindle runs in plain bearings. • Vernier scales to wheelhead and table swivels. • Fast cross-traverse to wheelhead for setting purposes.

For additional information, send for Micromatic Bulletin 206Q.

The 310 Cutter and Tool Grinder is designed to efficiently perform a wide range of grinding operations. Thus, tools and cutters can be ground in shortest possible time to keep production costs at a minimum.

FEATURES:

Universal operating positions—all within comfortable reach of operator. • Anti-friction cross saddle mounting assures sensitive control to cross feed. • Table traverses on precision roller chains, giving "fingertip" control. • Table dogs reversible—one end spring loaded and the other a dead stop. • Table swivels a full 90 degrees in left-hand direction and 45 degrees right-hand. • Large diameter wheel spindle, mounted on specially selected preloaded bearings. • Universal Cutter Head adjustable to swing from 8″ to 12″ diameters. • Cutter Head and Tailstock provided with clearance angle setting adjustments. • Attachments available to cover a wide range of tool and cutter grinding operations.

For additional information, write for Micromatic Bulletin 139W.

MODEL 310
CUTTER AND TOOL GRINDER

INVITE ANY COMPARISON

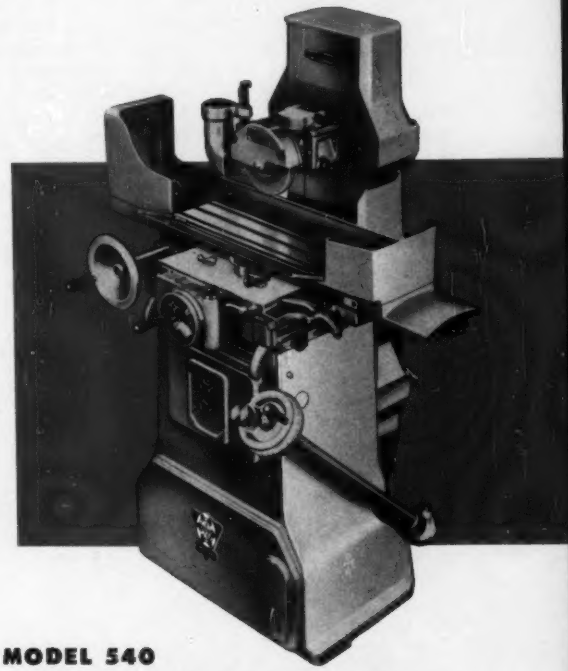
Operations, and Grinding Efficiency

The 540 Surface Grinder (6"x 18" capacity) has more than just the essential qualities required to provide high caliber surface grinding. Its simplicity of design provides ease of operation while inherent accuracy and efficiency assure excellent grinding performance. Thousands of these grinders have been purchased by discerning users in every part of the world.

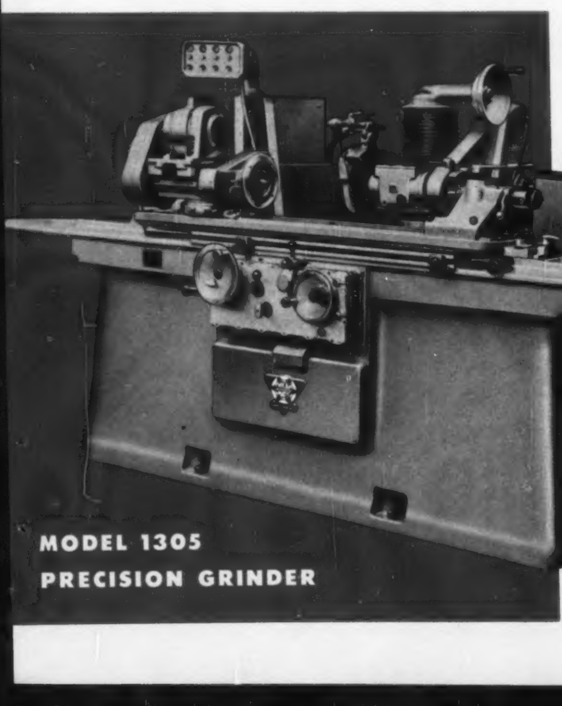
For additional information, send for Micromatic Bulletin C183.

FEATURES:

Completely centralized controls within easy reach of operator. • Patented low-pressure, long-life Hydraulic System operating from self-contained motor driven pump unit. • Table traverse rates variable from 5 to 40 feet per minute. Smooth and shockless reversing at maximum speeds. • Cross-feed automatically variable from .01" to .07" per stroke. • Hand controls provided for both traverse and cross-feed. Micrometer adjustment to cross-feed in .0001" divisions. • Vertical adjustment of wheelhead controlled by conveniently placed handwheel having a micrometer knob adjustment in .0001" divisions. • Wheelhead slide operates on ball bearing rollers running on precision ground bars, providing absolute sensitivity of vertical feed. • Automatic vertical wheelhead feed and electric lift (can be fitted as extra features). • Numerous attachments, including form tool grinding equipment, are available to assure full versatility.



MODEL 540
HYDRAULIC SURFACE GRINDER



MODEL 1305
PRECISION GRINDER

Models 1300, 1305 and 1310 precision grinders are of simple, accurate, and rugged design. The three capacities are: 8" swing and 18" between centers; 10" x 27"; and 10" x 40". Several types of wheelheads of proven design are available. For external cylindrical or taper, internal, and cutter and tool grinding, these grinders offer unusual efficiencies. Additional information regarding features and accessory equipment for these grinders is found in Micromatic Bulletin 208M; send for your copy.

FEATURES:

Shockless table reversal at all speeds. • Micrometer movements on table and cross-traverse. • Trouble-free, low-pressure hydraulic system. • Nitralloy wheel spindle running in plain bearings. • Super-accurate workhead spindle in selected plain bearings. • Surface finish to 1 microinch. • Parallel grinding to within .00025" in the center over 24". • Table reversal accuracies: .0005" for models 1300 and 1310, and .001" for model 1305, at maximum table speeds. • Minimum stroke of .020" at maximum table speed.

AN UNBEATABLE COMBINATION . . .

MICROMATIC SALES AND SERVICE

Since 1929, Micromatic has been constantly expanding every phase of its operation—plant, research, products, sales and services. And, the same unusual sales-engineering service that has typified Micromatic marketing activities for over thirty years, is now applied to the selling and servicing of these grinders. Specifically, Micromatic accepts full responsibility for every installation. Both the grinding machines and results obtained are guaranteed.

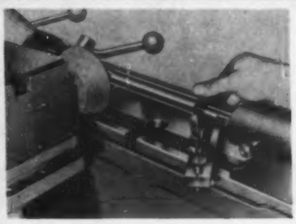
MICRO MATIC
HONE CORPORATION DETROIT, MICHIGAN

MANUFACTURED BY
JONES-SHIPMAN
LEICESTER, ENGLAND

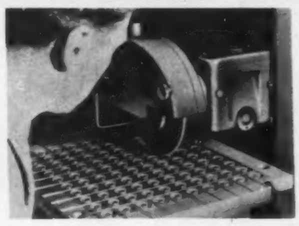
JONES-SHIPMAN DESIGN AND MANUFACTURING

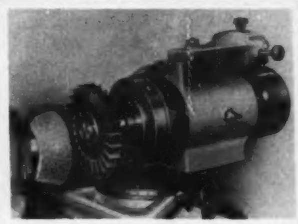
Jones & Shipman started business in 1898 and has been designing and manufacturing grinders since 1910. They maintain a continuous research and development program that is designed to keep their grinders ahead of the industry in all phases of operation and application. Manufacturing facilities are all modern and skilled personnel with years of experience—twenty-five percent of their employees have twenty or more years of service—assure highest quality workmanship.

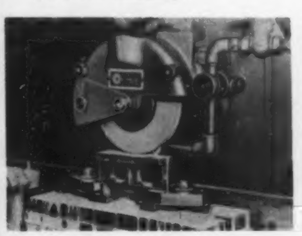
. . . FOR GRINDING APPLICATIONS LIKE THESE

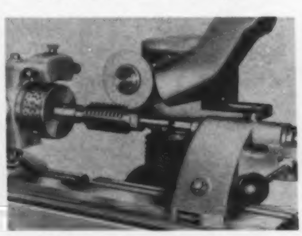

Grindingreamers—toothrest provides indexing.


Grinding a cutter—indexing finger is set to tooth spiral.

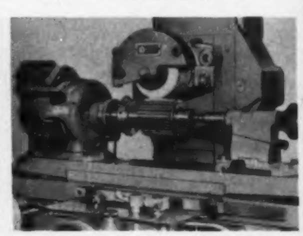

Grinding grooves in mold for miniature rubber tires.


Grinding the side faces of a side and face milling cutter.


Grinding gun-metal gate brackets for projectors.

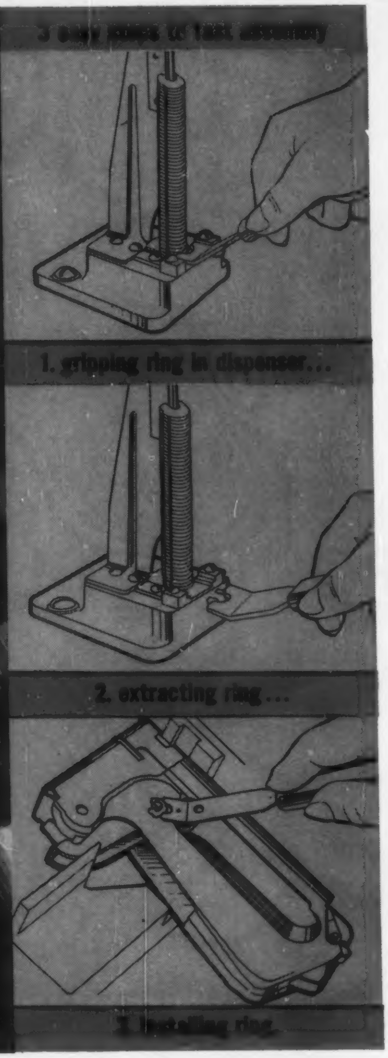

Grinding the flutes of hob—indexing attachment is used.


Form grinding the pad faces on valve rocker arms.


Optical dividing—finest reading is 6 seconds of arc.

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE • DETROIT 38, MICHIGAN

FOR ADDITIONAL INFORMATION,
write for literature that completely describes each grinder.



Truarc rings and dispenser speed staple gun assembly 60%

This big production increase was made by Swingline, Inc., Long Island City, N. Y. in assembling the handle lock of their high-compression staple gun.

To speed production, the Truarc Prong-Lock® Series 5139 retaining rings come *pre-stacked* for use on the Truarc *dispenser* (shown in foreground of photo above). Application is simple, fast and requires no skill. The operator, using the Truarc *applicator*, grasps the bottom ring, removes it from the stack, and installs it, quickly and easily, in the staple gun assembly.

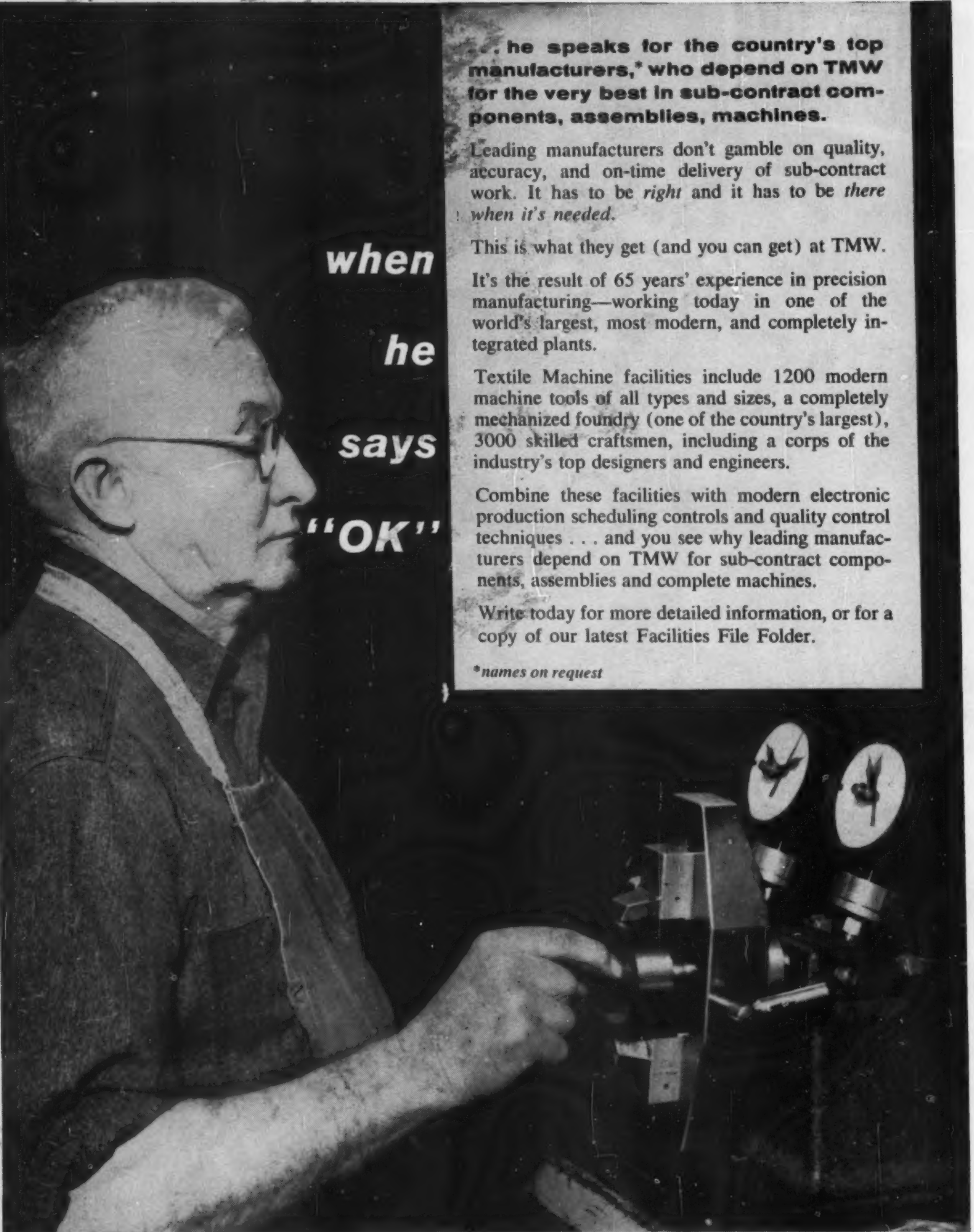
The Truarc ring replaced an ordinary flat "C" washer, previously used in this application. *While the unit cost of the washer was lower than that of the Truarc retaining ring, the use of the rings resulted in assembled cost savings of $25.00 per thousand staple guns.* The reasons: a 60% increase in production due to faster, easier assembly with Truarc tools, and the elimination of time-consuming, costly adjustments made possible by Truarc rings. What's more, the bowed Prong-Lock ring improved product design by providing resilient end-play take-up . . . eliminating looseness or binding in the parts.

Truarc retaining rings come in 50 functionally different types . . . as many as 97 different sizes within a type . . . 6 metal specifications and 13 finishes. Truarc assembly tools, pliers, applicators, dispensers and grooving tools are available to speed production of virtually every kind of product. Make sure you have on file the new 16-page Waldes Truarc Assembly Tool Catalog No. AT 10-58. Write for your copy today. And remember Waldes engineers are always ready to help you solve your special application problems. Waldes Kohinoor Inc., 47-16 Austel Place, Long Island City 1, N. Y.

WALDES
TRUARC®
RETAINING RINGS

Waldes Kohinoor Inc., Long Island City 1, N. Y.

TRUARC RETAINING RINGS...THE ENGINEERED FASTENING METHOD FOR REDUCING MATERIAL, MACHINING AND ASSEMBLY COSTS



. . . he speaks for the country's top manufacturers,* who depend on TMW for the very best in sub-contract components, assemblies, machines.

Leading manufacturers don't gamble on quality, accuracy, and on-time delivery of sub-contract work. It has to be *right* and it has to be *there when it's needed.*

This is what they get (and you can get) at TMW.

It's the result of 65 years' experience in precision manufacturing—working today in one of the world's largest, most modern, and completely integrated plants.

Textile Machine facilities include 1200 modern machine tools of all types and sizes, a completely mechanized foundry (one of the country's largest), 3000 skilled craftsmen, including a corps of the industry's top designers and engineers.

Combine these facilities with modern electronic production scheduling controls and quality control techniques . . . and you see why leading manufacturers depend on TMW for sub-contract components, assemblies and complete machines.

Write today for more detailed information, or for a copy of our latest Facilities File Folder.

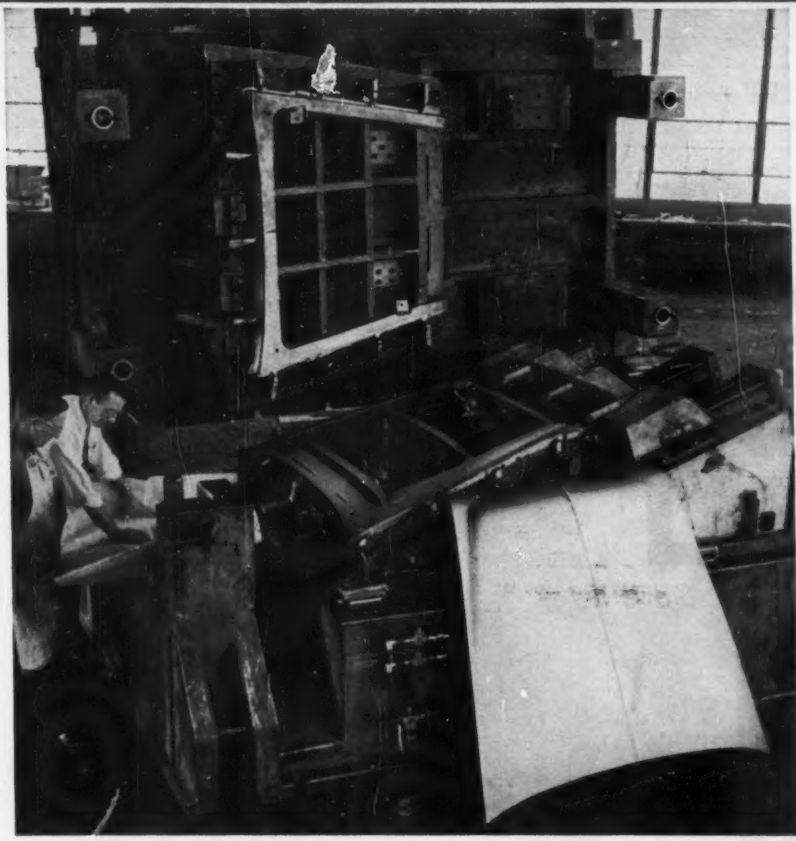
**names on request*

TMW

TEXTILE MACHINE WORKS

Contract Division • Reading, Pennsylvania

Tool Steel Topics



Automotive Die, in 101 Sections, Made from Water-Hardening Steel

This huge die, made up of Bethlehem W-1 carbon water-hardening tool steel, trims an automobile hood. Made from tool steel furnished by Peninsular Steel Co., Detroit, the die was photographed recently at Republic Die & Tool Company, Wayne, Mich. It contains 44 composite sections, 34 wear plates, and 23 solid sections.

Bethlehem carbon water-hardening steels were selected for this exacting application because of their good wear-resistance, easy machinability, and simple heat-treatment—plus ease of welding should repair become necessary.

Bethlehem carbon water-hardening tool steels, because of their carefully controlled hardenability, provide economical service in applications calling for high shock-resistance. And with their highly selective carbon range, they have good resistance to wear, plus the toughness to withstand cold battering.

If you have any questions about the use of Bethlehem carbon water-hardening tool steel, or any of our other popular grades, get in touch with your Bethlehem tool steel distributor. He's as near as your telephone.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Here's How to Stabilize Gages

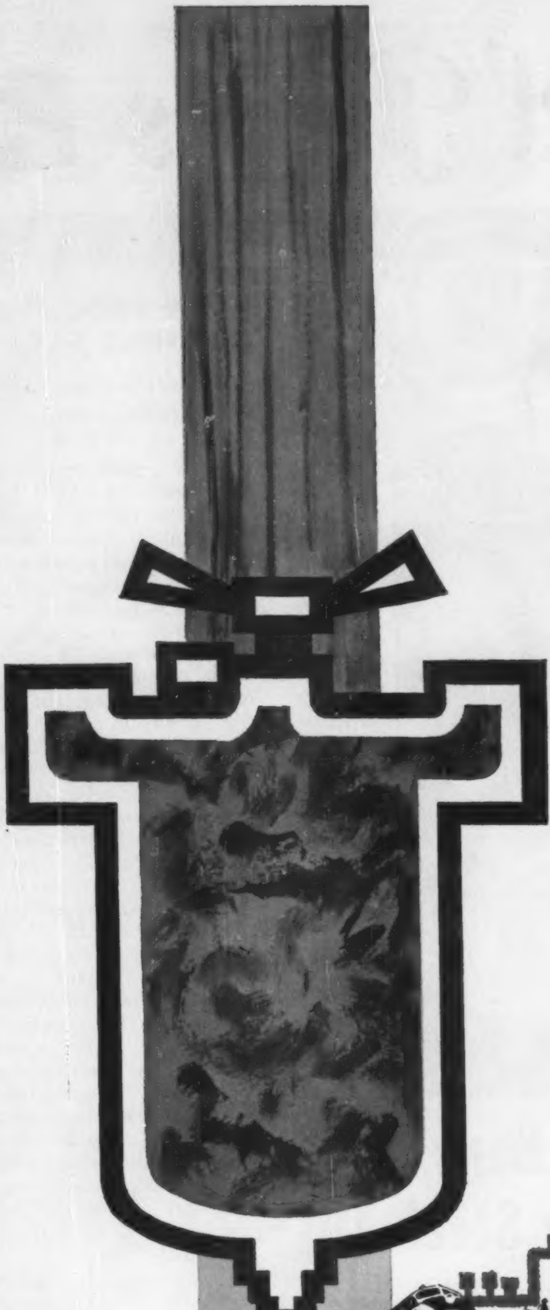
High-precision gages, commonly made of BTR tool steel (AISI Type 01), need a stabilization treatment if they are to maintain their accuracy for years. Otherwise expansion will eventually change dimensions outside of the permissible tolerance. These dimensional changes are in a magnitude of hundred-thousandths of an inch per inch, or smaller. Insignificant on ordinary tooling, they are important on precision gages.

The expansion which occurs over a period of time is due to the transformation of austenite retained during the quench for hardening. The object of the stabilization treatments is to transform the retained austenite during the treatment, so that none remains which could transform later on. This condition exists in all tool steel grades which can be hardened to Rockwell C 60 or higher.

The most common method for stabilizing high-precision BTR gages is: 1. Quench and temper in the normal manner to produce the desired hardness. 2. Rough grind. 3. Subzero cool to minus 100/120 F in refrigerator or dry ice. 4. Warm to room temperature and then retemper at original temperature. 5. Finish grind to size. 6. Repeat cycles of subzero cool followed by tempering five more times. 7. Lap or superfinish to size.

Sometimes it is possible to shorten this procedure, particularly if the design is such that there is little hazard of cracking. For example, the tools can be subzero cooled directly from the quench, with no interval at room temperature, followed by tempering and grinding. This will permit stabilization with only two additional cycles of subzero cool plus temper, but the disadvantage is that cracking may occur after quenching.

It is also possible to shorten the stabilization by cooling to minus 314 F in liquid air. This permits reducing the cycles of subzero cool plus temper to three instead of six.

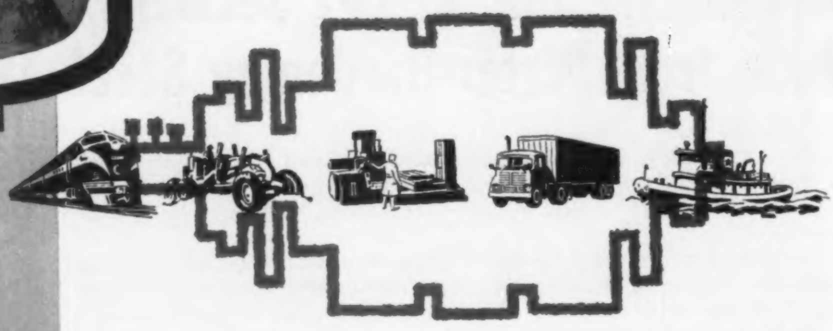


whatever the **power production application . . .** you can depend on **CUNO** engineered filtration

"The more complete the filtration, the more efficient the production of power." Cuno filters remove damaging contaminates and reduce costly stoppages.

To meet the specific requirements of *your* power production application, Cuno provides effective, engineered filtration with . . . Auto-Klean Self-Cleaning Edge-Type, Flo-Klean Automatic Self-Cleaning Wire Wound, Micro-Klean Disposable Depth Cartridge . . . available in a variety of housings.

Let us apply over 30 years of filtration know-how to *your* requirements.



CUNO

THE CUNO ENGINEERING CORP., DEPT. 11, MERIDEN, CONN.

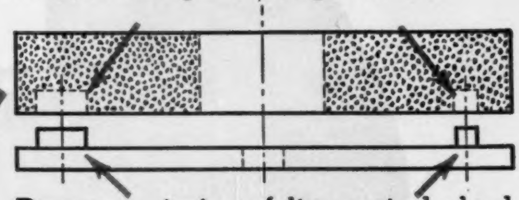
A Leader in Industrial Filtration for More Than 30 Years

Sales Offices throughout the United States and Canada

In Canada write: Peacock Bros., Ltd., P.O. Box 1040, Montreal 3, P.Q.

Gardner disc features add safety... improve accuracy

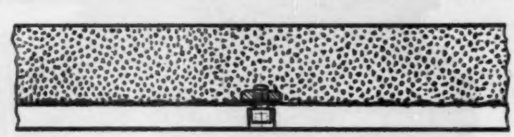
Gardner TRU-LOK® disc mounting
truer running—closer precision



Proper centering of disc on steel wheel assured by Tru-Lok.

Greater accuracy—Tru-Lok eliminates run-out and vibration caused by off center mounting.

Gardner WIRE-LOKT® construction
maximum safety—maximum economy



Full value—the entire rated thickness of the abrasive is usable.

Safety—heavy, imbedded steel mesh assures maximum safety.

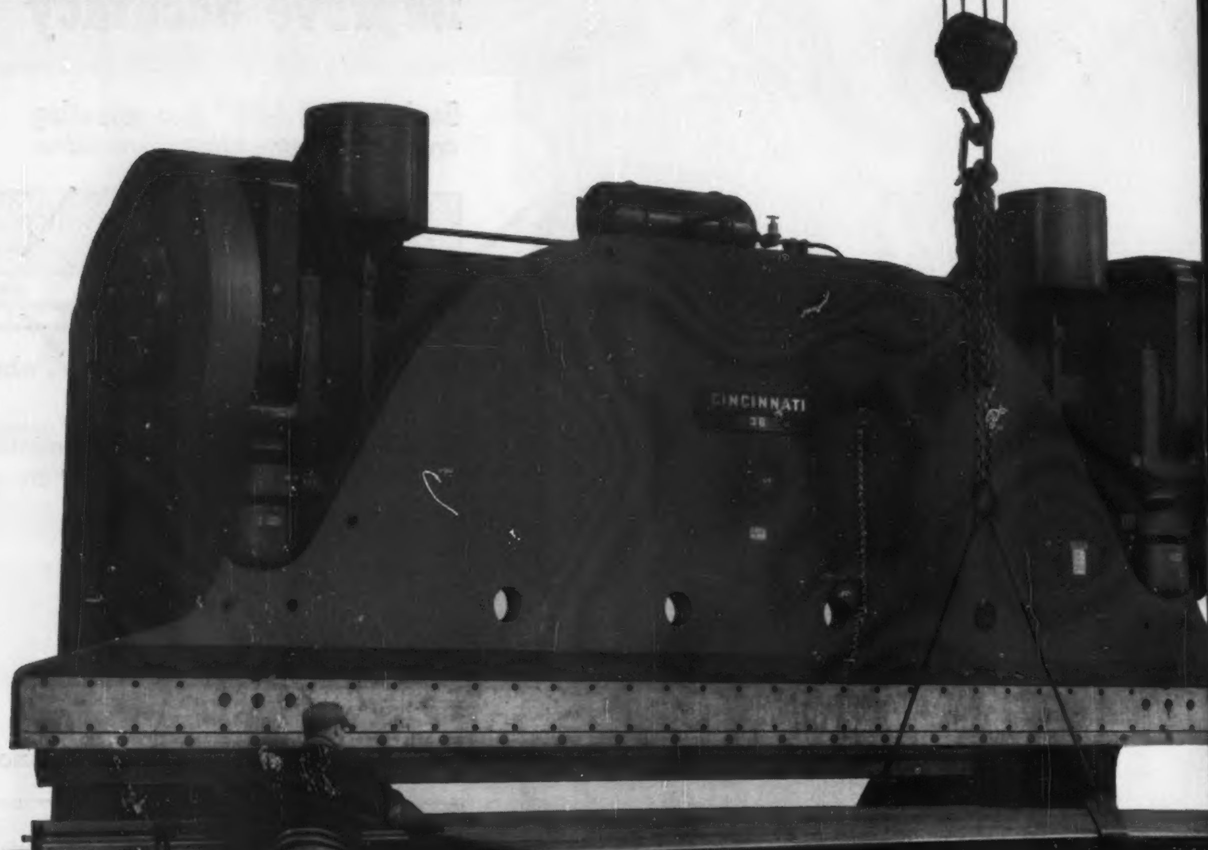
Call the man who can give you the *most* in practical, cost saving help with your flat surface grinding . . . your Gardner Abrasives Specialist.

GARDNER

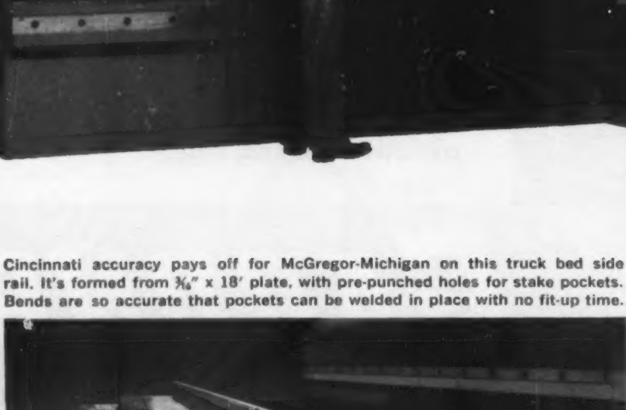
abrasive discs

BELOIT, WISCONSIN

McGregor-Michigan teams a Cincinnati Shear with its Cincinnati Press Brake to get maximum accuracy for its custom plate fabrication.



Cincinnati accuracy pays off for McGregor-Michigan on this truck bed side rail. It's formed from 3/16" x 18' plate, with pre-punched holes for stake pockets. Bends are so accurate that pockets can be welded in place with no fit-up time.



This CINCINNATI® PRESS BRAKE means

bigger jobs
fewer weld seams
less handling
easier operation

All four of these advantages mean money to McGregor-Michigan Corporation, Detroit. And they got all four of them when they bought a 36 Series Cincinnati Press Brake to be used along with their Cincinnati All-Steel Shear.

As a result, "this new brake . . . helps us be more competitive with some of the larger shops," says R. Hilprecht, sales manager of this steel plate fabrication shop.

This is just one example of the way Cincinnati Press Brakes and Shears are cutting costs and opening up new business for shops across the country. They quickly pay for the extra refinements you get in Cincinnati-built machines.

Write Dept. D for new Catalog B-12, and pick the brake that will mean new profits for you.

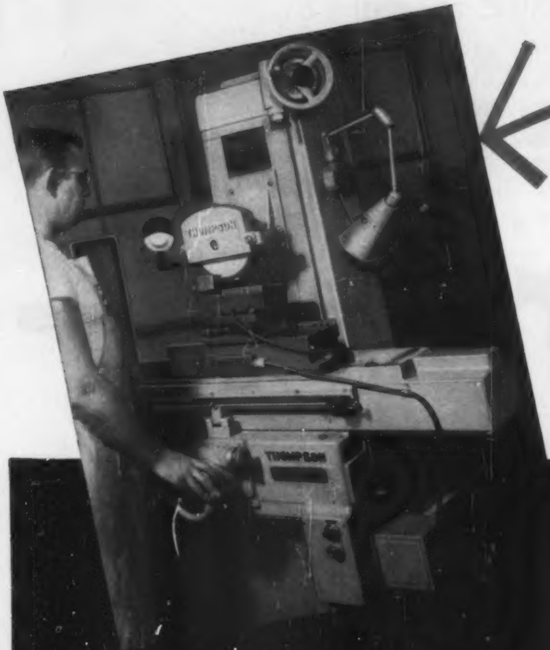
Shapers / Shears / Press Brakes

CINCINNATI ®

Cincinnati 11, Ohio, U.S.A.

THE CINCINNATI SHAPER CO.

For more data, circle this page number on inquiry card



Completely Satisfactory in Every Way

. . . says Mr. William H. Vogt, Division Superintendent of Parts and Tool Manufacturing at Taylor Instrument Companies, Rochester, N. Y.

NEW TYPE D Hand Feed SURFACE GRINDER

is ruggedly designed for precision work.

OFFICES IN ALL PRINCIPAL CITIES

Taylor Instrument Companies

for the home TEMPERATURE & WEATHER INSTRUMENTS *for industry* TEMPERATURE PRESSURE HUMIDITY FLOW & LIQUID LEVEL INSTRUMENTS

SUBSIDIARIES IN TORONTO, CANADA LONDON, ENGLAND MELBOURNE, AUSTRALIA

95 AMES STREET
ROCHESTER 1, N. Y., U. S. A.
May 7, 1959

Mr. John C. Wilson,
Vice-President, Sales & Engineering
The Thompson Grinder Company
Springfield, Ohio

Subject: THOMPSON Type D Surface Grinder

Dear John:

We have proven the new Thompson Type D Tool Room Grinder by rigid tests in our Tool Grinding Department. We find it completely satisfactory in every way.

We find these decided advantages on the new Thompson:

1. Its ease of adjustment
2. Its ruggedness and rigidity
3. Its bedway and column protection
4. Its large vertical capacity
5. Its cross-feed movement obtained by moving the wheel head rather than using a saddle, which permits accurate grinding of slots.

Everything considered, we find, in our work, the new Thompson Type D a very superior precision machine.

Yours very truly,

William H Vogt

William H. Vogt
Division Superintendent
Parts and Tool Manufacturing

whv:lb

With men like Mr. Vogt, who rate tool room grinders solely on their performance, Thompson's new Type D machine is winning enthusiastic approval.

Send for descriptive literature on this new Type D machine and compare the advantages it offers you in cost-cutting time-saving and trouble-free performance. Immediate delivery is available.

"Keep Thompson in mind for that daily grind"

Thompson SURFACE GRINDERS

THE THOMPSON GRINDER CO. **SPRINGFIELD, OHIO**


FEDERAL
MIRACLE MOVEMENT
DIAL INDICATOR
FEDERAL
FEDERAL PRODUCTS CORPORATION
PROVIDENCE, R.I. U.S.A.
Model C5M
.0005"
JEWELED

UNIVERSAL BORING CHUCK is heavy and rigid for all types of rough boring without chatter yet accuracy of adjustment adapts it equally well to finish boring. Time-tested Universal Collet nose holds boring tool much more rigidly and securely than set screws while precision and extreme accuracy of feed-adjustment are obtained by an anti-backlash arrangement of feed screw and large dial.

UNIVERSAL RELEASING TAP CHUCK has same basic collet principle featured in all Universal Collet Chucks. Screws or sleeves are not needed and collets are interchangeable with other Universal chucks. Simple, compact design has no springs, cams or pawls to break or wear. Can be used for either right or left hand tapping without adjustment.

HIGH PRESSURE REVOLVING COOLANT TRANSFER CHUCK has standard Universal Collet Chuck nose and a variety of shank sizes can be held by simply changing collets. Minimum overhang is made possible by the single face seal design. Back pressure principle of this design prevents "brake" action thus lowering torque on spindles. Chucks for higher speed and pressures than standard plus a variety of mountings are also available.

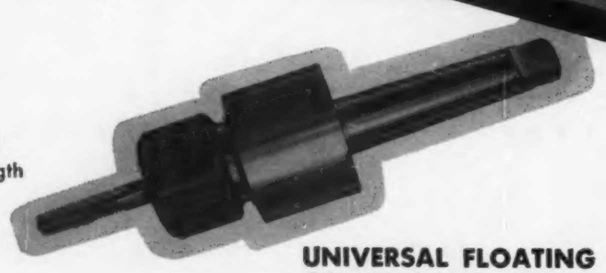
UNIVERSAL

COLLET CHUCKS

combine maximum holding power and minimum run out with simplicity of design and low price

The basic collet principle is the same in all Universal chucks. Tools gripped in these chucks withstand a maximum thrust and radial load because the collet grips on a continuous surface its full length and positively locks the tool. Write today for new catalog showing the complete line of Universal collets and chucks.

210

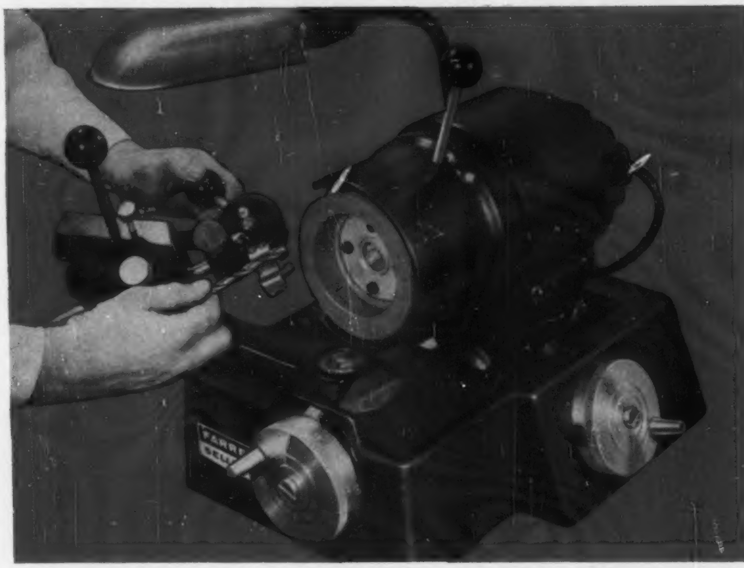


UNIVERSAL FLOATING COLLET CHUCK for horizontal or vertical operation is positively protected against destructive action of coolant by a seal which prevents entrance of compounds into interior of assembly. Frictionless ball bearing flat springs are adjustable to counter-balance weight of the tool.

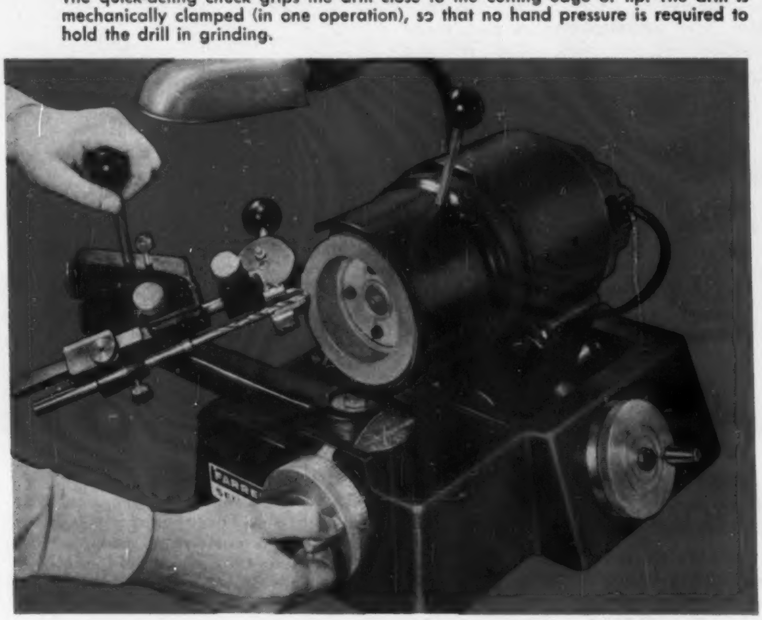
UNIVERSAL ENGINEERING COMPANY

FRANKENMUTH 2, MICHIGAN

New speed and accuracy for grinding small drills



Setup is easy and fast—no adjustments, bushings or wheel changes are required. The quick-acting chuck grips the drill close to the cutting edge or lip. The drill is mechanically clamped (in one operation), so that no hand pressure is required to hold the drill in grinding.



The chuck holds the drill in proper relation to the wheel so that a scientifically correct point is automatically produced. A handwheel is provided on the right side of the machine to move the grinding wheel from left to right, thereby maintaining a flat face on the grinding wheel and eliminating the necessity for frequent dressing of the wheel. No skill is required to produce accurate points.

This new self-contained bench-type drill grinder is designed to grind either straight or tapered shank, right-hand, 2-lip twist drills, in sizes from No. 70 to 1" diameter, to any included angle of point from 60° to 150°. Broken drills, usually discarded, can be easily restored.

The 1-GA grinds one lip of the drill completely and then, with every condition the same, grinds the second lip, after the drill has been rotated 180 degrees in the chuck. The drill is held so that, regardless of eccentricity in the drill or wear in the chuck, the point is exactly on center.

As the drill alone is revolved to grind each lip, there is no chance of machine error creeping into the result. The point generated is scientifically correct, with the lip clearance increasing proportionately from the periphery to the chisel point. Result: drill points that cut faster, drill through more inches of metal per grind and produce true cylinders of accurate size.

Write for *new* bulletin 4104, which describes this fast, accurate grinder in detail.

FARREL-BIRMINGHAM COMPANY, INC.
CONSOLIDATED MACHINE TOOL DIVISION
565 Blossom Road, Rochester 10, N. Y.
Telephone: BUtler 8-4600
Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.

CM-49

FARREL SELLERS ®

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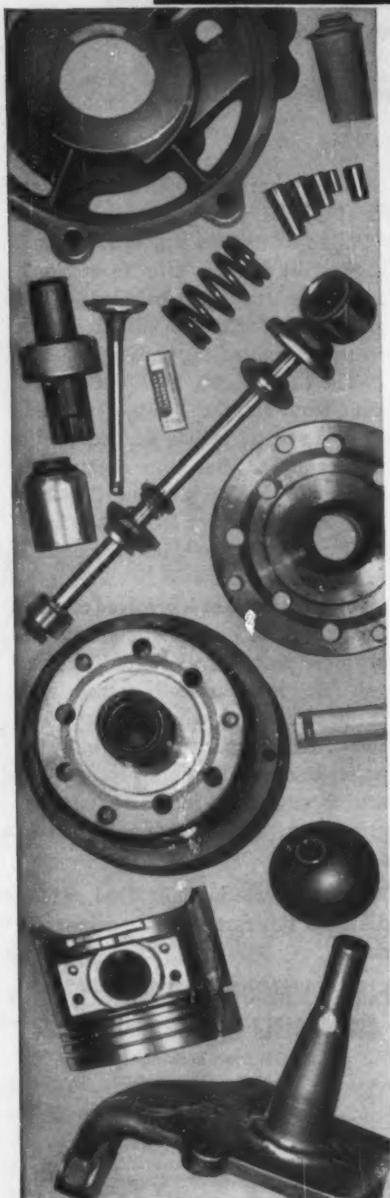
practical automation ideas ....#2



GEAR-O-MATION
Division of Michigan Tool Company
7171 E. McNichols Rd., Detroit 12, Mich.

Yes! I want to see the time- and money-saving ideas in your new "Idea File." Have your field engineer show it to me soon!

Name____________________

Company____________________

Street____________________

City____________________

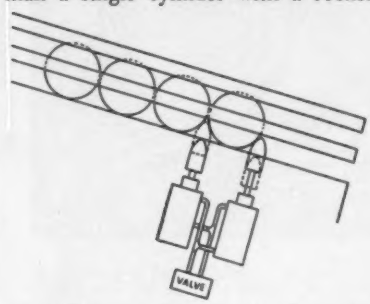
Why Waste Floor Space?

Often a Gear-O-Mation 'overhead' demand storage unit can provide all the in-process storage and demand feeding you need. Can be used between widely separated operations. Tracks of unit are self-cleaning to avoid maintenance up under the ceiling.

Want to see Gear-O-Mation's "Idea File"? Every Gear-O-Mation field engineer has one. Drop us a line and we'll tell the one handiest to your company.

Two Cost Less Than One

Simple twin air cylinders, working alternately can release parts for demand feed at a lower cost, frequently, than a single cylinder with a rocker



arm. The arrangement is also more positive and can give faster 'in' and slower 'out' movement to prevent parts jamming or accidental escape.

The Old Town Pump

Many practical automation ideas come from old principles. Example: Use of the old town water pump to elevate parts on demand. Instead of bringing up water, a cage instead of a plunger brings up a part. The cage opens the gates. Elevation is by a simple piston rod.

When it comes to actuating devices—electrical, mechanical, hydraulic or pneumatic—it is Gear-O-Mation's policy to use only proven equipment, thus lessening chances of service interruptions and making sure reliability is not sacrificed.

"Freeway" Interchange for Parts

If you have the need to switch parts on demand from, say, either of TWO 'inbound' to either of two 'outbound' tracks, Gear-O-Mation has a simple way of doing it with air operated gate. Particularly useful where you are feeding two machines from two others.

Flip-Flop Press Feeder

An oscillating arm with built-in hydraulic clamp can pick up a part from the loading chute, load it into a press, reverse it, remove it and place it on the unloading chute or conveyor.

A basic principle at Gear-O-Mation is to look always for the simplest answer to any problem of handling of parts in process. Usually they find it, too. Nine times out of ten, the simplest way is usually the most practical.

2-Strand Chain Does Whole Job

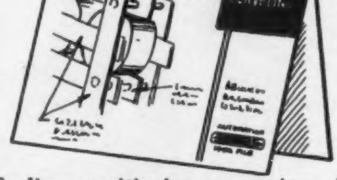
Rotating continuously in a vertical plane, a 2-strand chain with A, B and C pockets receives parts, feeds them into machine 'A' for operation 'A', takes them back, feeds them into machine 'B', gets them back again, feeds them into machine 'C'. Exit chutes into machines serve as loading magazines.

Automating for Worker Safety

Positioning of small parts in relation to large ones in welding or riveting machines sometimes presents a safety hazard to hands. A simple solution is a positioning arm with a formed end which swings into place by simple cam action after the large part is inserted. The small piece is then pushed into position by the machine and the positioning arm retracts, leaving the part in place.

SEE THIS "IDEA FILE"

Every Gear-O-Mation field engineer now carries with him an "Automation Idea File." It contains sketches and details of practical answers to many parts handling problems—orienting,



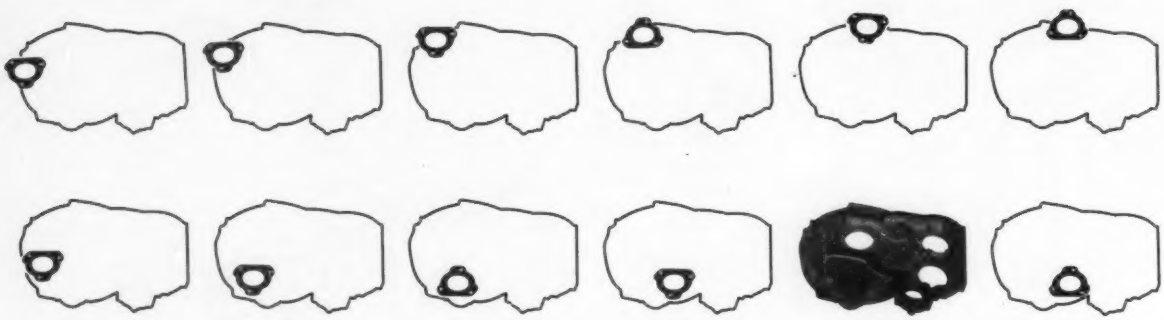
feeding, positioning, conveying, distributing, etc. These ideas will suggest variations to suit your exact needs. Have a Gear-O-Mation field engineer go through the "Idea File" with you soon! Use the handy coupon at left.

GEAR-O-MATION
DIVISION OF MICHIGAN TOOL COMPANY
7171 E. McNICHOLS RD. • DETROIT 12, MICH.

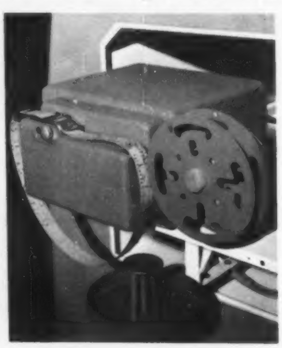
Tape Control Speeds Production

This workpiece comes in many varieties . . .

One multi-spindle Natco machines them all



Numerical control for the production line? Sure! And it's paying its way machining starter holes in over 160 different flywheel housings for small diesels. Even though the starter mounting pads are located differently on each of the housings, this Natco handles each new part with equal ease. It bores the hole for the starter pinion shaft; drills and taps three mounting holes around it.



That's the beauty of tape control—the flexibility it gives machine tools like this three column Natco special. Here's practical automation for small lot production!

It's easy and fast to change to a different part. Just substitute a new tape loop in the reader and rotate the drillheads to the new setting. In minutes you're cutting metal again.

No battery of expensive fixtures needed with this machine—the tape locates the part under the drillheads by controlling the motion of the worktable. And inventory can be cut to the bone because even small lots of service parts are run at production part cost.

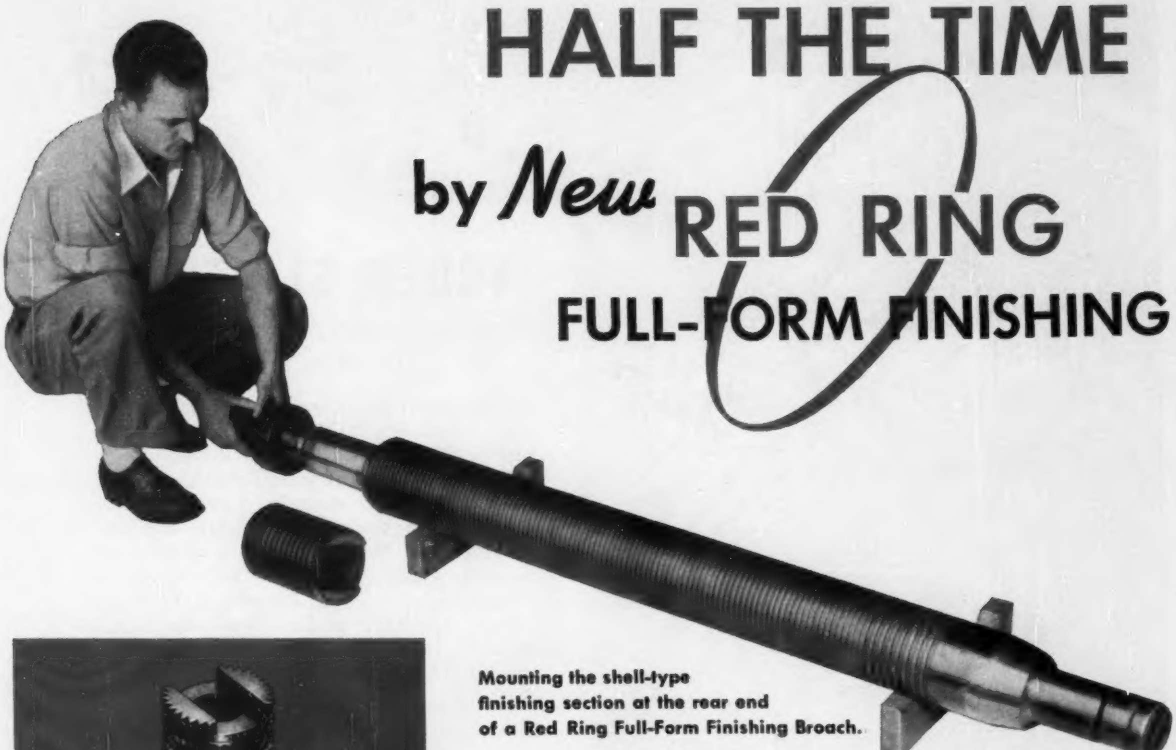
Production lines don't have to wait until tomorrow for numerical control. It's here now, and now is the time to gain the greatest advantage. Let us show you how it can be used to speed your boring—drilling—facing—tapping—reaming jobs. Call your Natco representative today, or write for details.

NATCO NATIONAL AUTOMATIC TOOL COMPANY, INC., RICHMOND, IND.

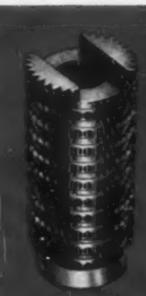
CLOSER TOLERANCE GEARS IN

HALF THE TIME

by *New* RED RING FULL-FORM FINISHING



Mounting the shell-type finishing section at the rear end of a Red Ring Full-Form Finishing Broach.



Finishing section

Internal running gear completed in one pass.

An entirely new concept in broaching precision gears and splines for automotive and aircraft industries has significantly reduced production costs and at the same time materially improved gear quality. Both roughing and finishing are completed in a single pass of the tool.

Broached tooth surfaces are not only true to form but are entirely free of the generating tool marks which are unavoidable with conventional broaching tools. Surface smoothness checks out between 5 and 8 microinches in the direction of broach travel.

The secret lies in the ingenious design of this new Red Ring broach (patents pending). The roughing section generates gear teeth in the conventional manner. Following the roughing teeth is an interchangeable shell-type section having 12 rows of finishing teeth. Each row cuts about 0.00025" of stock on the full profile of each side of the gear teeth—hence the remarkable tooth surface smoothness attained.

Using this method on a 3.5" PD, 35 tooth internal running gear, a prominent transmission builder found broach life of the roughing section to be 50,000 work pieces—that of the finishing section, 150,000 pieces.

Write for specific data regarding the application of Full-Form Finishing to your operations.

SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING,
GEAR HONING AND ELLIPTOID

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

8348

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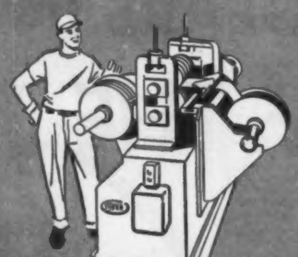
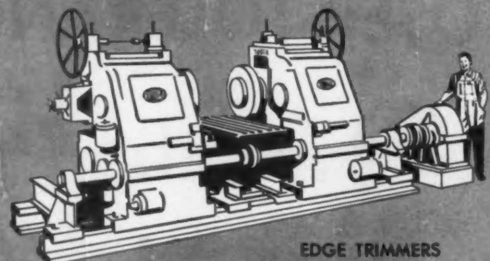


SELF-CONTAINED SLITTERS



EDGE TRIMMERS

YODER SLITTERS

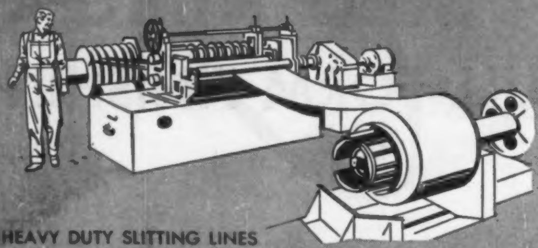
basic equipment for cost-conscious users of strip!

To help meet the demands of tight production schedules, YODER Slitters reduce mill-width stock quickly and economically to desired widths. If your needs are as low as 100 tons per month, time and manpower savings alone will offset the cost of your YODER Slitter in a matter of months, while reducing basic inventories. Compactly designed, standard YODER Slitters are built to handle standard coil widths . . . completely engineered lines for special requirements.

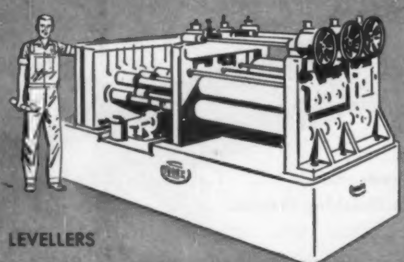
YODER accessories, such as coil cars, swivel unloaders, scrap choppers, scrap disposers, plate levelers and coil boxes, make stock handling fast and easy.

YODER also makes a complete line of Cold Roll-Forming equipment and Pipe and Tube Mills. To profit from YODER'S years of engineering and service experience, contact your local YODER representative or send for the fully illustrated descriptive, YODER Slitter Manual; it's yours for the asking. Write to

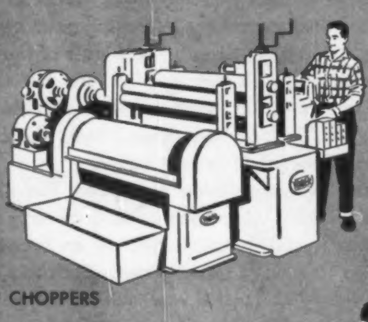
THE YODER COMPANY
5504 Walworth Ave. • Cleveland, Ohio



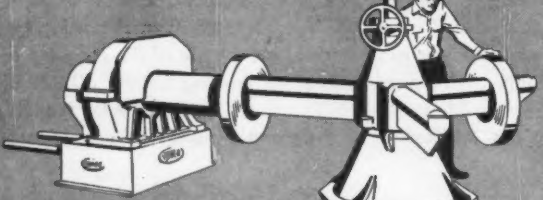
HEAVY DUTY SLITTING LINES



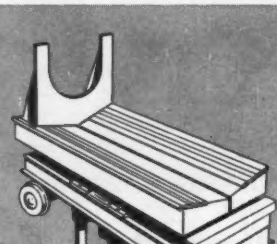
LEVELLERS



SCRAP CHOPPERS



3-ARM UNLOADER

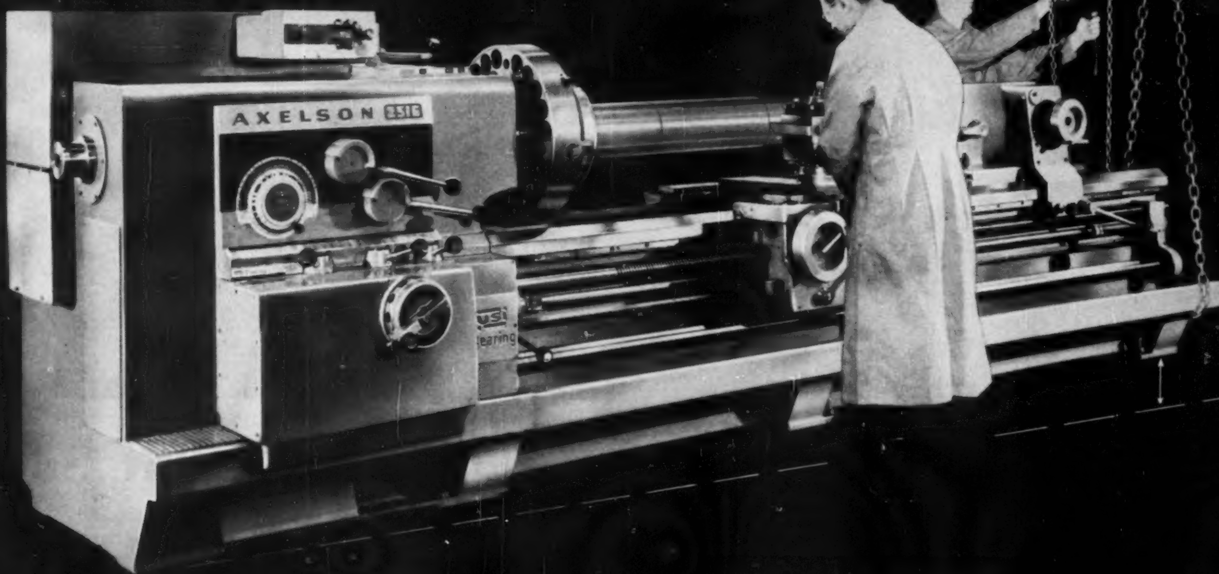


COIL CARS

ENGINEERING **YODER** MANUFACTURING

ROTARY SLITTING LINES
PIPE AND TUBE MILLS (ferrous or non-ferrous)
COLD ROLL FORMING MACHINES

WHAT DOES THIS STARTLING TEST MADE ON THE NEW CLEARING-AXELSON LATHE MEAN TO YOU?



In a recent demonstration before editors of the metalworking press, Clearing repeatedly raised and lowered one end of the Blue Chip lathe with an overhead crane—<u>while the lathe was running</u>. Accuracy on the ¾" cut in progress was held within .002" across the full length of the workpiece.

Certainly, you aren't going to operate a lathe with one end hanging from a crane. The test we made with the new Blue Chip lathe simply demonstrates the enormous rigidity of its all-steel bed. Why such rigidity? Demands placed on lathes by ceramic and sintered carbide tooling necessitates extreme stiffness and rugged construction in order to hold tolerances on heavy, high-speed cuts.

Here's What This Rugged Construction Means To You

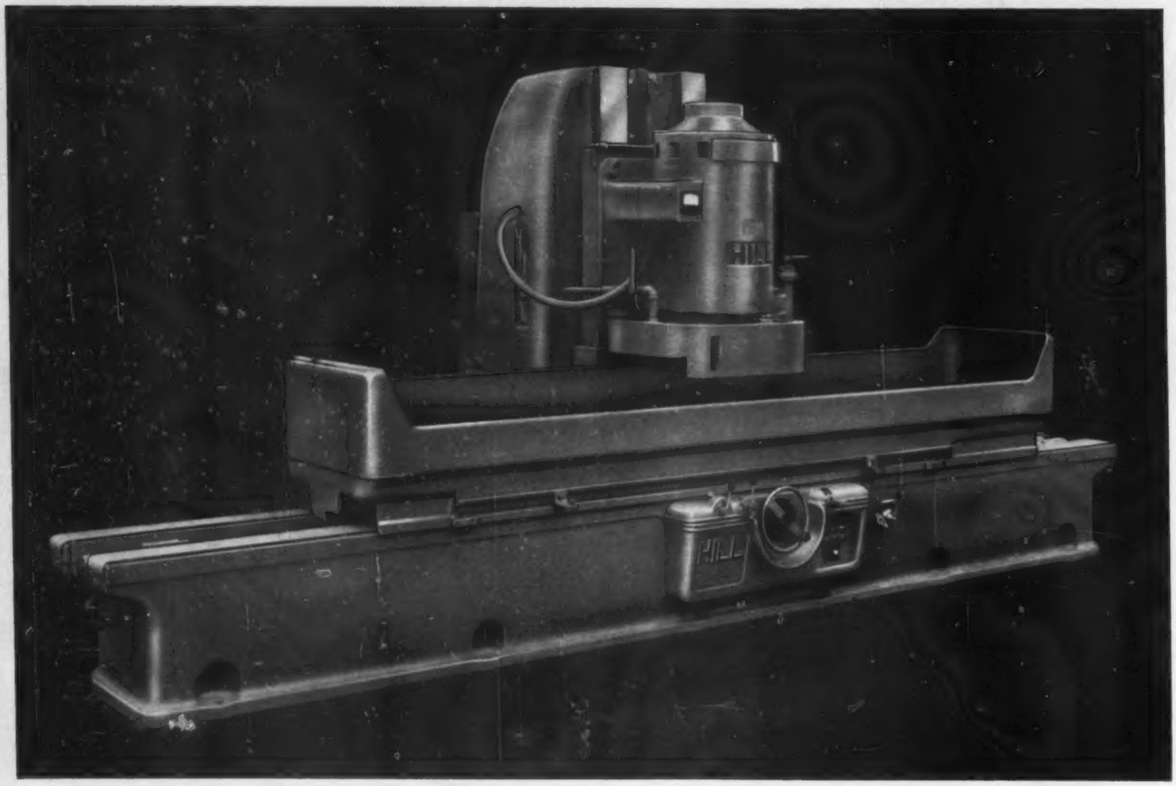
Greatly Improved Tool Life—Reduced Breakage. Production Potential Unheard of With Conventional Equipment. But there is more—much more—than just 18 times greater rigidity in the Blue Chip story: For all the facts write for the Clearing-Axelson Blue Chip Lathe catalog. We'll send it promptly. Clearing also distributes the Clearing-Harrison Lathe in sizes from 11" to 16".

Write for New Catalog on Blue Chip Lathe

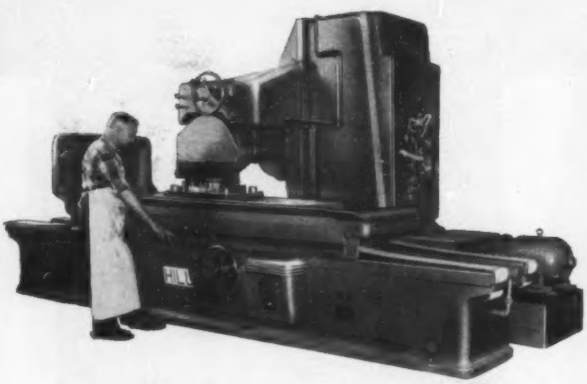
USI Clearing

DIVISION OF U. S. INDUSTRIES, INC. 6499 W. 65th Street • Chicago 38, Illinois

PLANTS IN: CHICAGO LOS ANGELES HAMILTON OHIO



Hill Grinder ELIMINATES MILLING OPERATION



For grinding to extremely close tolerances on flats, angles, irregular and special shaped surfaces the HILL Horizontal Spindle grinder is recommended.

Expensive, time consuming milling operations can be eliminated in finishing die blocks, bolster plates etc. with the new HILL Vertical Spindle Hydraulic Surface Grinder. Equipped with either 75 or 100 HP main spindle motor, the segmented grinding wheel provides fast stock removal and produces an accurate finish in approximately half the time required for a combined milling and grinding operation.

The HILL fully hydraulic reciprocating table is adaptable to a wide variety of stock sizes having flat surfaces. Table widths are 18″, 24″ and 30″ with table lengths from 5 to 20 feet.

HILL ACME TOOLS FOR INDUSTRY

The HILL ACME Company

1201 WEST 65th STREET, CLEVELAND 2, OHIO

Also manufacturers of: HILL GRINDING AND POLISHING MACHINES • "ACME" FORGING MACHINES • ROTARY SCRAP SHEARS • ALLIGATOR SHEARS • "CLEVELAND" KNIVES AND SHEAR BLADES • MATERIAL HANDLING EQUIPMENT • BAR-BILLET SHEARS

A Winning Combination...

"American" HOLE WIZARD RADIAL + INGENIOUSLY DESIGNED FIXTURES

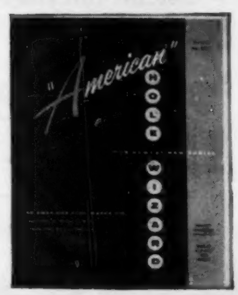
The time on this job was cut to the bone by the combination shown by the illustration. All boring, facing, drilling, tapping and counterboring on the entire job was done in one work setting by means of an ingenious swiveling fixture.

The essential contributor to satisfactorily performing this variety of work is unquestionably the "AMERICAN" Double Lo-Hung Spindle Drive. This is an exclusive "AMERICAN" Hole Wizard feature. It divides the speed range into two separate ranges; the high speeds through a comparatively small gear to minimize gear velocities; the low speeds through a large diameter, wide faced gear to reduce gear tooth pressures to insure minimized wear under severe service.

To further reduce wear and to insure maintenance of original accuracy the spindle and sleeve are made of nitralloy steel nitrided for extreme surface hardness and are mounted on large precision Timken Bearings with convenient outside adjustment which guarantees maximum life, dependable operation and unequalled spindle stability for the life of the machine.

These exclusive "American" features permit your putting your radial drills to work at a profit

There are other advantages too — write for bulletin No. 328.



THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

LATHES AND RADIAL DRILLS

46% gain in production with BAKER®

ADJUSTABLE SPINDLE MACHINE

Standard Baker Vertical Adjustable Spindle Drilling Machine.

Cutting production time on an individual part from 6 minutes to 2 minutes, 47 seconds is typical of the production efficiency delivered by a new BAKER drilling machine at a leading manufacturer of power transmission equipment.

The average overall production increase is 46%.

It's flexible, too. Altogether 35 different parts are run across it.

For extra economy, BAKER design permits easy and quick maintenance.

This demonstration of BAKER speed and flexibility proves again that BAKER basic units are the foundation of today's most efficient drilling and tapping operations.

Perhaps *your* "special machine" problem can be solved by a BAKER standard vertical or horizontal unit fitted with the necessary components.

For the full story on these BAKER machines, write to: BAKER BROTHERS, INC., Dept. MH-959, 1000 POST STREET, TOLEDO 10, OHIO.

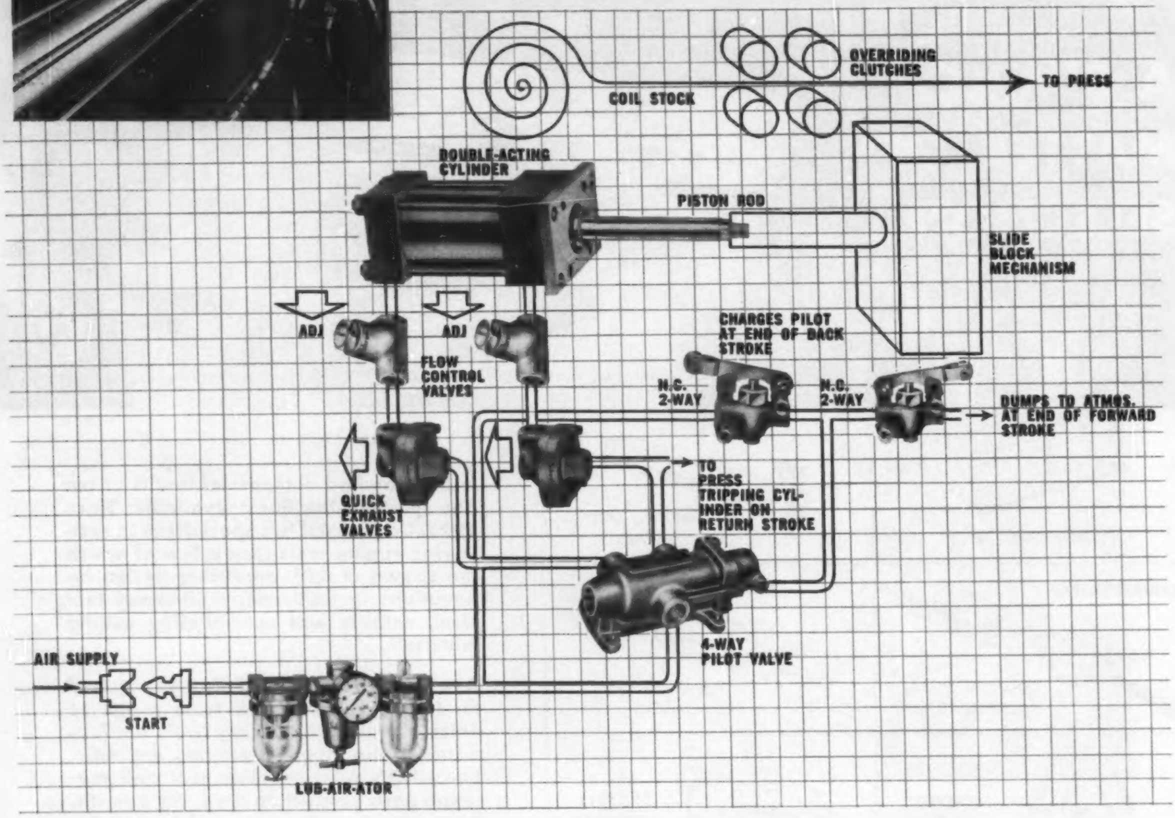
NOW... COMPLETELY INTERCHANGEABLE

TO FIT 3 SIZES VERTICAL MACHINES	21 ADJUSTABLE SPINDLE HEADS 27 FIXED SPINDLE HEADS 3 TYPES STANDARD TABLES	TO FIT 3 SIZES HORIZONTAL MACHINES

BAKER®

STANDARD AND SPECIAL DRILLING AND TAPPING MACHINES • COMPRESSION MOLDING MACHINES • AUTOMATIC BAR MACHINES

This is an example of how OEM use Schrader. The hookup of Schrader Air Products in the large schematic is used by the Cooper-Weymouth Company of Stratford, Connecticut, to operate its patented power press slide-feed. Power to the mechanism is supplied by a Schrader double-acting cylinder, the front head of which is machined as an integral part of the overriding clutch. At the end of the forward stroke, the slide block operates a normally-closed 2-way valve, which dumps the pilot of a 4-way control valve. This reverses cylinder piston, and the slide block mounted on it, to return for the next stroke. Another normally-closed 2-way valve ahead of the pilot charges the 4-way pilot in a conventional reciprocating motion arrangement to start the next cycle.



ORIGINAL EQUIPMENT MANUFACTURER BUILDS STANDARD SCHRADER AIR PRODUCTS INTO AUTOMATIC TOOLS FOR SPEED, PRECISION

If your company *manufactures* machines or equipment that must push, pull, hold, position or move work repetitively . . . consider the advantages of actuating them with air. Schrader makes complete lines of Air Products that can do such jobs with dependable precision. In limitless combinations, they adapt to many special needs.

Air offers manufacturers much more than versatility. It's fast and accurate, can time to fractions of seconds at high speeds. Its economy alone is a powerful sales point. Safe, tireless, air power is simple that problems of weight, assembly, production and maintenance are enormously reduced.

These are benefits all customers look for. Add them to your products by actuating with Schrader . . . finest, most complete lines of Air Cylinders, Valves and Accessories.

Select from the full Schrader lines to plan your automation of machines. Your Schrader distributor can help you pinpoint what you need. For more data write:

Schrader®
a division of SCOVILL

A. SCHRADER'S SON
Division of Scovill Manufacturing Company, Incorporated
454 Vanderbilt Avenue, Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

4 Types of Multi-Unit Automatics for High Production to Close Tolerances

Each of these four machines on our assembly floor is a different type. Each one is the most efficient setup for its particular job.

But these different types of machines are alike in these ways —

- **Operations.** Drill, counterbore, ream, tap, mill (light cuts), etc.
- **High production.** A number of automatic units of ½ to 5 hp each perform different operations at the same time.
- **Close tolerances. Few rejects. Little downtime.** Each machine has good basic design and rugged accurate construction.
- **Ready to produce.** Samples run for approval before shipping machine.

For a specific proposal ask our representative in your area. Or write us. Kingsbury Machine Tool Corp., Keene, New Hampshire.

REPRESENTATIVES

California	Los Angeles 22	Moore Machinery Co
Connecticut	West Hartford 7	O C Stevens Mchy Co
Illinois	Chicago 51	Four States Mchy Co
Indiana	Indianapolis 20	C C Garrett Mchy
Michigan	Detroit 19	Birmingham & Conner
	Grand Rapids 4	Joseph Monahan
Missouri	St. Louis 24	R R Stephens Mchy Co
New York	Long Island City	Triplex Mach Tool Co
	Syracuse 1	Syracuse Supply Co
Ohio	Cincinnati 2	E A Kinsey Co
	Cleveland 3	Golden & McCoy Co
	Dayton 2	C H Gosiger Mchy Co
Pennsylvania	Philadelphia 6	John S Wright, Mchy
	Pittsburgh 37	Merit Machinery Inc
Canada	Toronto 8	Barker Indus Eq Ltd

REGULAR INDEXING

For most high production work. Perform successive operations from one direction or several. Index units in four sizes: 12-, 20-, 26- or 40-inch. Four to 10 stations (12 with 40-inch).

CENTER COLUMN INDEXING

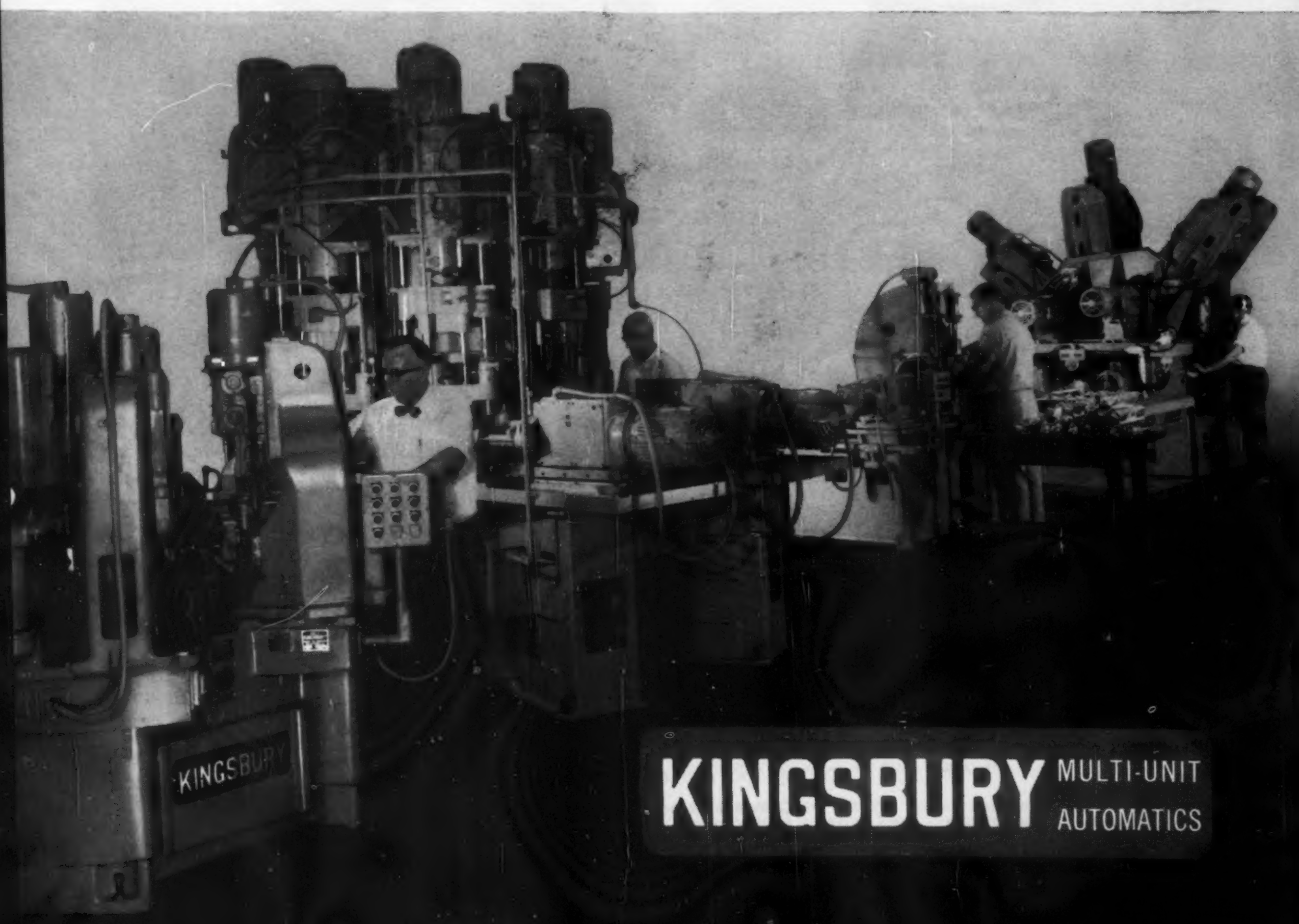
For more operations or larger parts than the regular indexing machines can handle. 8 to 14 stations. 43- or 63- inch index table. Horizontal units mounted on knees. Easy access to tools.

NON-INDEX (WAY TYPE)

For operations from 2 or more directions on one part at the same time. When a job needs successive operations, two or more of these machines may make the most efficient setup.

VERTICAL INDEXING

For successive operations from opposed directions with up to 5 horizontal units on each side of the machine. Up to 4 radial units provide a third direction. 8 stations in a vertical plane.



Q

S

A

Motch & Merryweather's

Quality, Service and Availability add up to lower production costs

Triple Chip cut-off blades and slitting saws—characterized by a specially-developed tooth form—cut faster and last longer.

M&M's factory repair, resharpening and resegmenting service, the fastest in the industry, helps you avoid excessive inventories . . . minimizes costly downtime.

The complete line of M&M cutting tools, stocked by M&M distributors strategically located in every important industrial area, enables you to get immediate delivery on the tools you need, when you need them. Sawing and cutting tool specialists are always available to help you solve tough or unusual sawing problems.

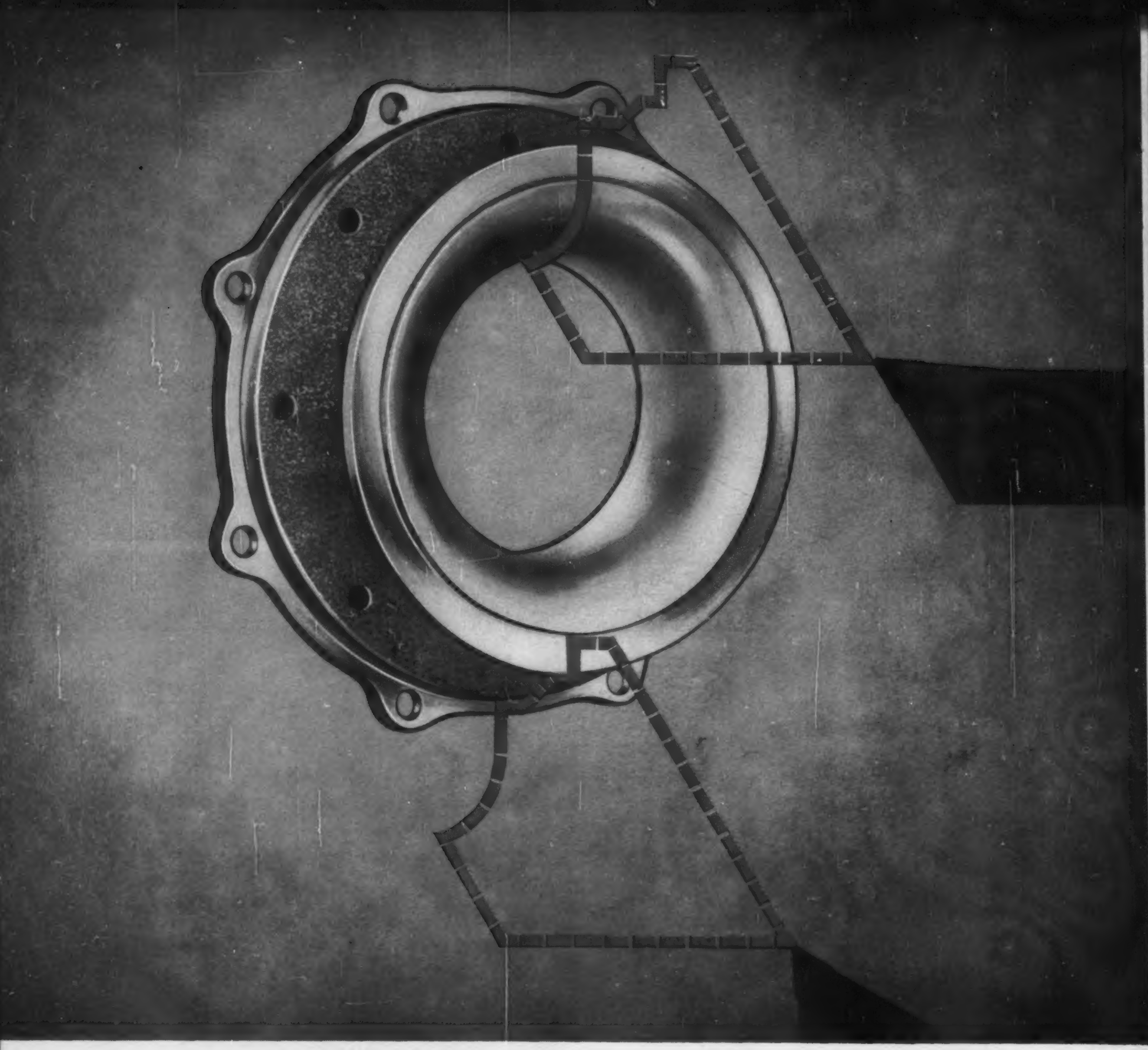
Always specify Motch & Merryweather . . . first in quality . . . first in service . . . first in availability.

FREE—*Send today for your copy of M&M's Circular Sawing Handbook, a pocket-sized guide to sawing operations.*

THE MOTCH & MERRYWEATHER MACHINERY CO.

Cutting Tool Manufacturing Division

Cleveland 17, Ohio

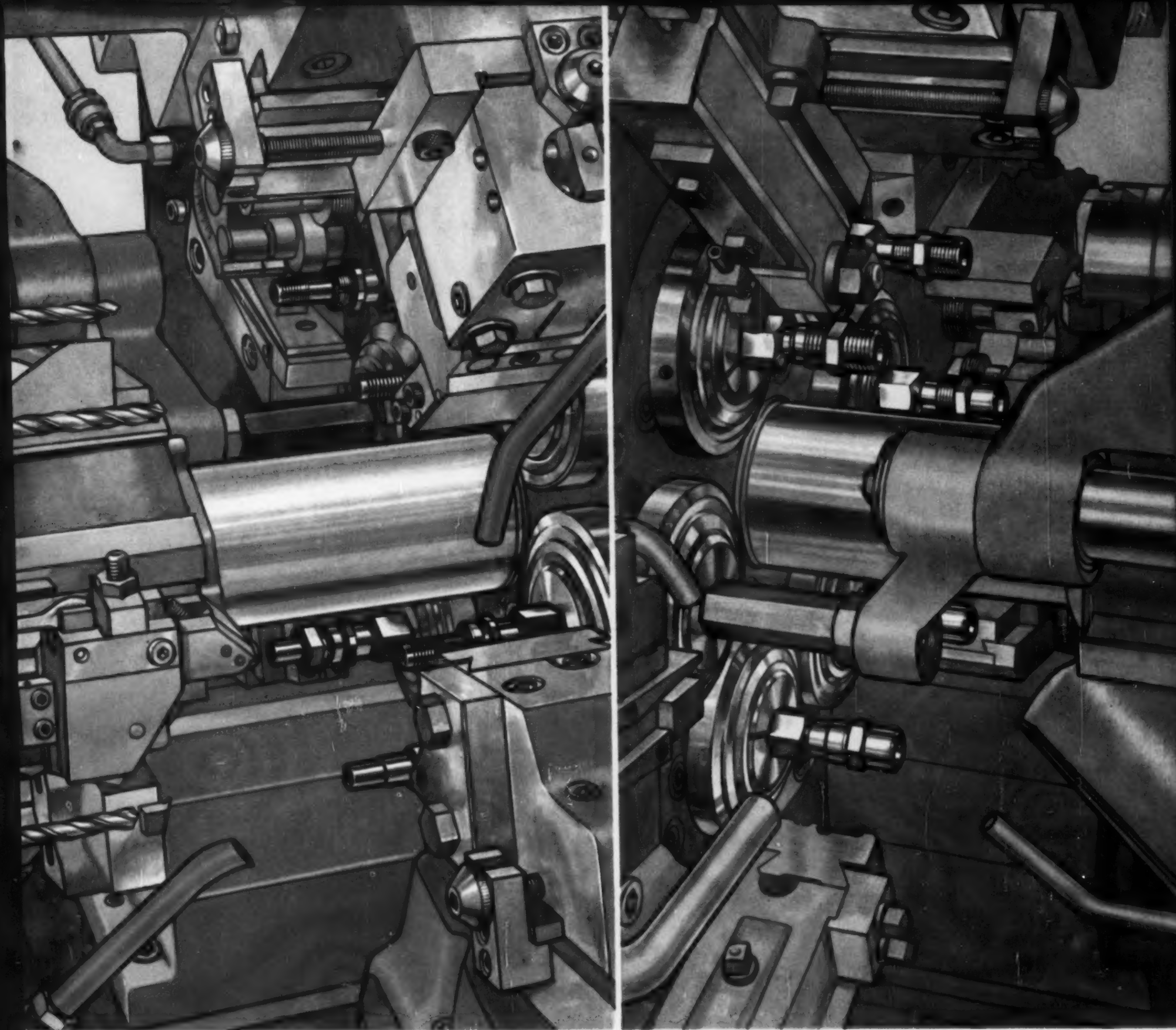


seven *surfaces to turn:*
one *template,* **one** *slide,* **two** *tools.*

Machine tools are rarely if ever bought because somebody thinks they might come in handy. They are bought because a specific job needs to be done and because a particular machine is judged best fitted to do it. However, no matter how specific your need may be, *versatility* is the greatest by-product you can buy, and the greatest assurance of a profitable investment.

Perhaps your problem is economical, long-run production of a contoured shaft piece. Well and good: your best bet is a New Britain +GF+ copying lathe. Now let's suppose you develop a requirement for only a few hundred pieces like the one illustrated. Your New Britain +GF+ is every bit as efficient. Simple tooling; fast setup; rapid, accurate production.

The applications for contour turning are very broad. If you have contour turning, boring and facing work on shafts or chucking work, you should be interested in the New Britain +GF+. Many shops whose production requirements wouldn't justify very expensive, lightning-fast production can make highly profitable use of one of the basic models because of its versatility, accuracy, fast setup and inexpensive tooling. At the other end of the scale, you can't touch our machines for tremendous volume work. Obviously, this subject is much too broad and too important to do justice to it here. We would like to send you literature that spells things out in much more detail. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

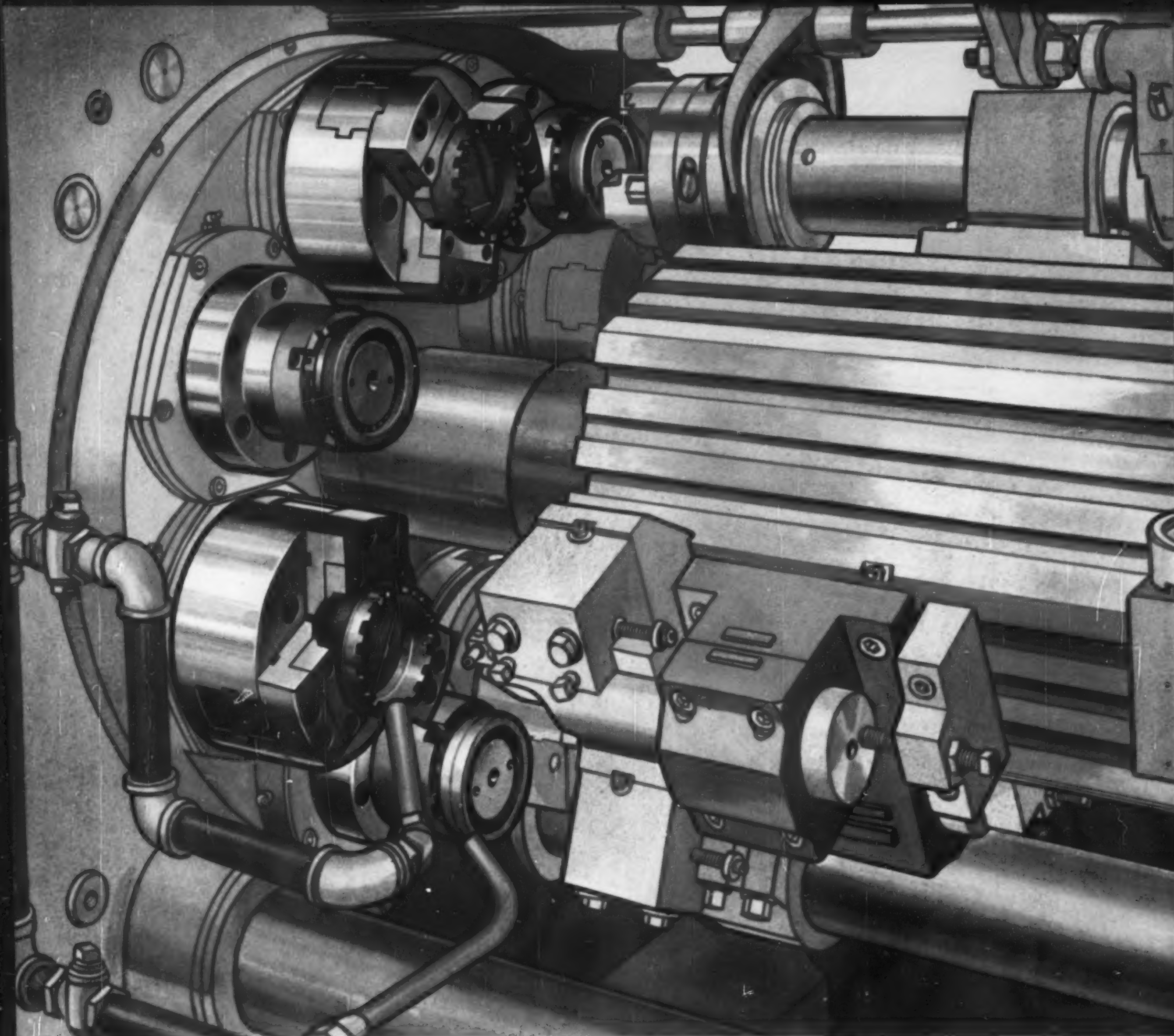


stainless, **225** *per hour—brass* **1500** *per hour.*

Up to a point increased machine productivity is a matter of refinements, additions, skillful tooling and perhaps more power. Eventually you achieve about all the efficiency that can be built into equipment of conventional design.

To achieve a major break-through in bar machine productivity necessitated redesign from the ground up. New Britain has done it with such success that we are able to offer the metalworking industry a whole new family of machines with performance unequalled anywhere. Independently cammed cross slides open up a whole new world of tooling possibilities. Power and spindle speeds are adapted to the important new metals and alloys. Increased chucking capacity allows application of New Britain standards of speed and accuracy to much larger pieces. None of the famous New Britain exclusive features which preserve accuracy and increase accessibility over other machines have been sacrificed. The chart below tells part of the story, and we have complete literature available to spell it out completely on the models which interest you particularly. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

Model	Spindles	Cross Slides	Spindle Speeds	Spindle Capacity	H.P.	Weight
45	4	4	43-526	5″	30-50	46,000
52	6	6	271-4250	1 1/4″	15-25	12,800
62	6	6	177-3000	1 5/8″	15-30	18,800
62	6	6	177-3000	2 1/4″	20-30	18,875
82	6	6	64-633	3 1/2″	30-50	46,000
83	8	6	99-1504	2 5/8″	30-50	46,000



Announcement

New Britain's new and completely modern Rebuild-Retool Center at Bridgeport, Michigan, is important to every present and prospective owner of New Britain Automatics.

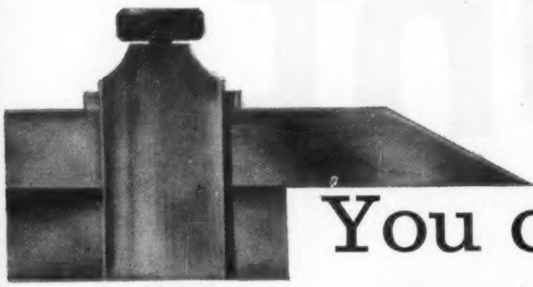
This is the first center established exclusively for the rebuilding and retooling of production machinery. It is staffed by men trained specifically for this type of work. It is equipped specially for putting New Britains back on the job with maximum efficiency in minimum time, at minimum expense to the owner.

Rebuilding and retooling may be "orphan jobs" elsewhere, but they rate top treatment at New Britain. Here is an important extra reason for selecting a New Britain when you purchase new equipment—a full time specialist organization devoted to protection of your investment.

If you would like to investigate the profit potential in a complete modernizing program, or could profit from a factory-engineered retooling of one or more machines, write us either at New Britain, Connecticut, or Bridgeport, Michigan. The New Britain Machine Company.

The Norton Measure of Value . . . the true measure of savings on materials you buy for your production is the cost-per-piece produced.

Call your Norton Man — he has the experience, the products, and knows how to save you money where it counts. There's a Norton expert in the fields of — abrasives . . . grinding machines . . . refractories.



You can produce greater savings than you can buy

You can't recognize a value by its price alone. This is true of all types of grinding wheels and has special significance in diamond wheels in view of their high initial cost.

The price tag on a diamond grinding wheel may appear to be a good "buy," but the real consideration should be what will you get for your money?

Less expensive diamond grinding wheels than Norton wheels may save you money on immediate cost. But if the lower cost wheels do not perform their jobs efficiently or cause production delays because of poor quality or wheel misapplication — the price you paid is too much.

The only accurate measure of the value of any grinding wheel is how much it produces for you per dollar cost — not merely how much you paid for it. Here is why Norton diamond grinding wheels are worth more to you —

Norton Company introduced all three diamond wheel bond types, does all its own sizing and checking of diamonds — duplicating wheel specification with constant accuracy. Norton certifies the carat content, assuring full value for your money. Whether the diamonds you use in carbide grinding are mined or man-made, Norton gives you the most advanced research engineering and manufacturing facilities in the entire abrasive field. And you get this great scope of detailed knowledge on a personal basis — your Norton Man.

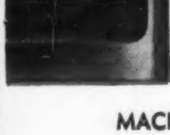
Your Norton Man starts his career by spending a minimum of one year in a carefully planned training course in the Norton plant and a comparable period of training in the field. The Norton Man has an average of 15 years' abrasive experience in addition to the specialized training. He is the most knowledgeable man in abrasives that you can consult. Make him your consulting abrasive engineer.

Ask him to make an Abrasive Requirement Study for you. This study lists the correct specifications for each abrasive job in your plant to assure you lowest cost-per-piece produced. He is also available for complete field testing on specific problems. For example —

Your Norton Man can increase production by pointing out ways for more effective wheel usage. He has the widest selection of grinding wheels in the industry from which to select the best wheel for new product grinding operations and for improving your current grinding jobs — both at the lowest cost. And with Norton grinding wheels you can be sure of precise duplication order after order.

Norton offers true abrasive economy. Economy that pays off in lower cost-per-piece produced. Call your Norton Man. NORTON COMPANY, General Offices, Worcester 6, Massachusetts. Plants and distributors around the world.

W-1917



NORTON

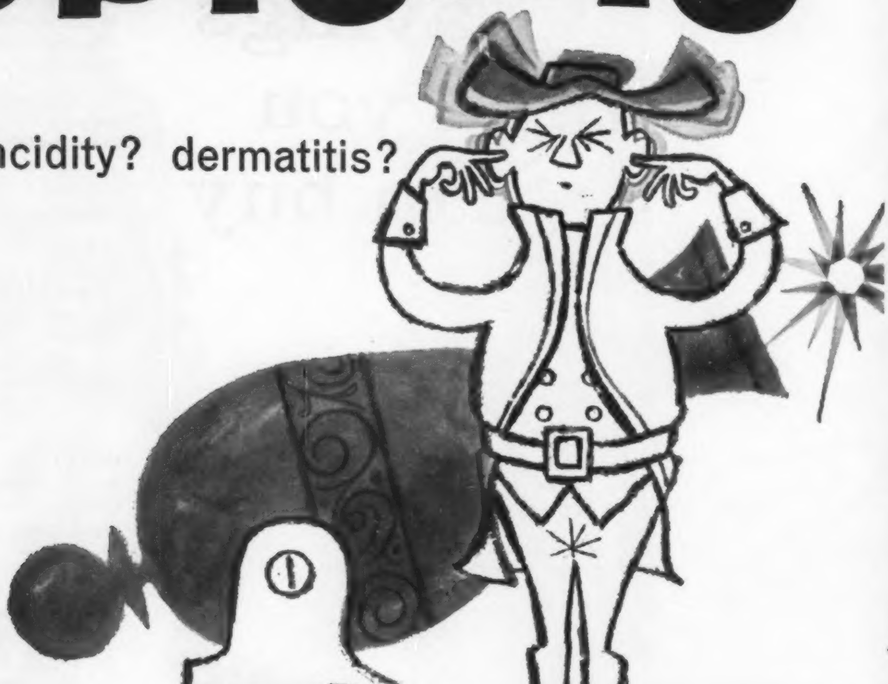
ABRASIVES

Making better products... to make your products better

For more data, circle this page number on inquiry card

coolant problems

rust? rancidity? dermatitis?



Cold Stream stops rust resists rancidity reduces causes of dermatitis These problems start when your coolant gets dirty. Cold Stream stays clean week after week—even on cast iron. Cold Stream gives longest tool life. Finest finishes. Highest speeds and feeds. Best dimensional control. Cold Stream gives you everything you ever expected in a coolant!

JOHNSON'S

cold stream

Stays clean week after week and gives you all the performance you pay for.

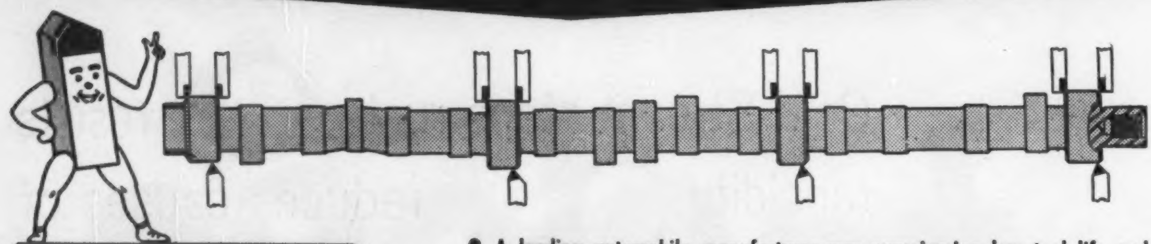
JOHNSON'S WAX

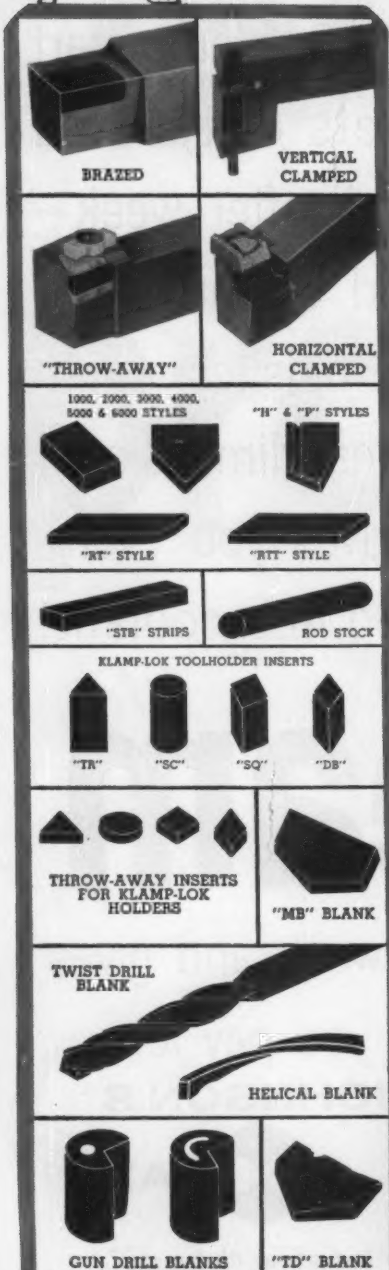
For information, see your local Johnson industrial distributor.

"Cold Stream" and "Johnson's" are trademarks of S. C. Johnson & Son, Inc., Racine, Wisconsin

For more data, circle this page number on inquiry card

1020 CAMSHAFTS MACHINED WITH Talide® C-91!





• A leading automobile manufacturer was experiencing low tool life and high costs machining camshafts made of tough, highly abrasive cast iron alloy. Talide tool engineers installed Grade C-91 with following superior results:

GRADE C-91 CASE HISTORY

Part .... Automobile camshaft
Material ...... Cast Iron Alloy 1.8165 dia. x 23-1/2" long, 260 Brinell
Operation ..... Rough turning 4 bearing surfaces
Machine ...... Sundstrand Model #8 automatic

Tools .... 4 Talide TB-123-3/8" I.C. x 1-1/2" long triangular inserts, Grade C-91, mounted in Klamp-Lok toolholders
Depth of Cut .. 1/16" to 3/32"
Feed 0.12
Speed .... 130 (S.F.M.) 274 (R.P.M.)
Coolant .... Soluble Oil

Results.... Talide Grade C-91 machined 1020 camshafts per grind compared to 550 for 2nd best competitive grade and 275 for 3rd best. Special attention to the grind and chip breaker detail resulted in Grade C-91 outperforming all other grades used previously.

QUALITY CONTROL GUARANTEES TOP TOOL PERFORMANCE...

Determining rupture strength of test bar. Hardness is determined on Rockwell machine, center.

Leco and Burrell instruments are employed in the analysis of metal oxides.

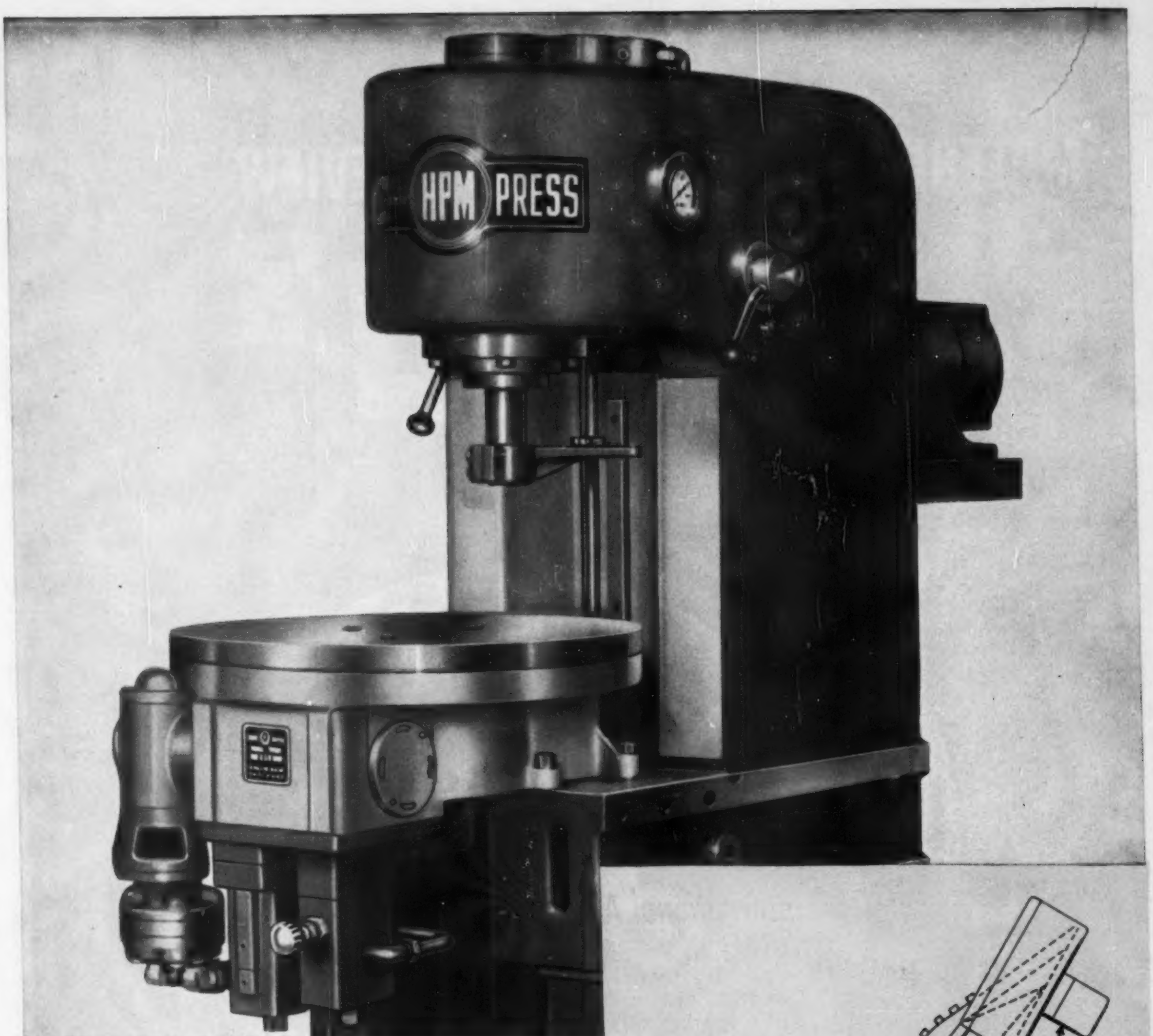
• A constant research program at Metal Carbides pays off in improved Talide grades having extra high hardness, strength, rupture resistance and crater resistance properties. Processed in latest type vacuum electric furnaces—all Talide grades are uniform and consistent in quality.

Write for Catalog 56-G

METAL CARBIDES CORPORATION
MC
TALIDE®
YOUNGSTOWN 12, OHIO

Metal Carbides Corporation
Youngstown 12, Ohio

HOT PRESSED AND SINTERED CARBIDES • VACUUM METALS
HEAVY METAL • ALUMINUM OXIDE • HI-TEMP. ALLOYS
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY



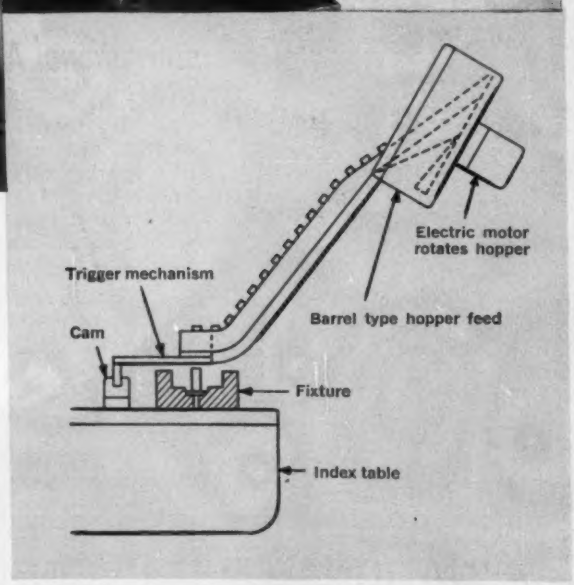
This packaged potential for complete automation requires only proper tooling to make it 100% automatic. Retooled for specific jobs its usefulness can be extended many times.

PRACTICAL AUTOMATION UNDER $10,000

Eliminates Parts Handling, Eliminates Manual Skill

Both quality and production output benefit when the H-P-M automatic index table is put to work. With all press motions easily preadjusted for correct pressure, stroke and ram speed, the uniformity of force applied to finished parts is removed from the realm of guesswork. With automatic loading of parts for many small assemblies, manual effort is removed from the job. These two elements, in combination, assure better quality, faster production at lower cost.

The H-P-M C-Press is available in 5, 10, and 15-ton models for the bulk of mass produced assembly work in your shop. Let an H-P-M field engineer explain how low cost automation with H-P-M's can be put to work for you; how this initial investment in modernization can be applied and reapplied to countless production tasks.



Many small parts can be hopper fed as typified in this sketch. Eliminate the fumbling and slowdown of feeding small parts manually and your production will improve by "hundreds" per day.

HPM

H94S

THE HYDRAULIC PRESS MFG. COMPANY
A Division of Koehring Company, Mount Gilead, Ohio, U.S.A.

MATERIALS & FABRICATION PREVIEW

of the SOARING 60's

METAL SHOW
CHICAGO

International Amphitheatre, Nov. 2-6, 1959

Here is an atmosphere steeped in discovery of the future — a preview of the kind of metalworking magic and technical wizardry that will propel America into the soaring 60's. Inspiring exhibits and thought-provoking technical sessions will draw 50,000 men of metalworking into a dynamic conclave of progress-producing activity.

Plan NOW to attend — you'll come away with new ideas, better equipped for the challenge of competition in the 60's!

EXHIBITORS . . . A FEW EXCELLENT SPACE LOCATIONS STILL OPEN—WRITE, WIRE OR CALL COLLECT FOR LIST OF AVAILABLE BOOTHS.

NATIONAL METAL CONGRESS and EXPOSITION

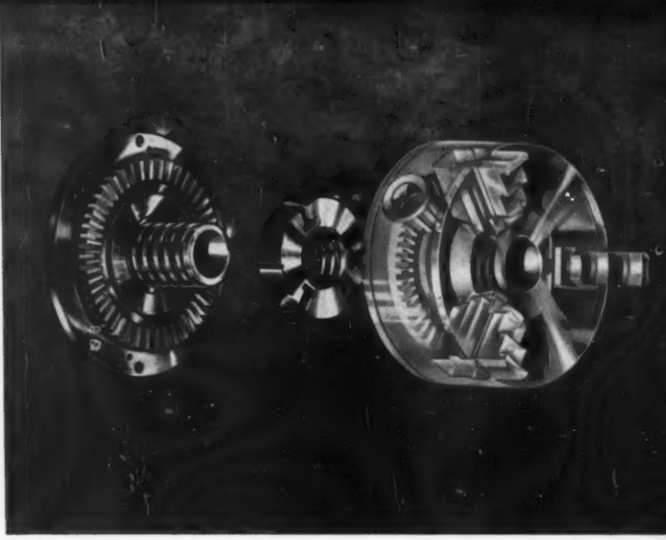
Sponsored by the AMERICAN SOCIETY FOR METALS
Metals Park • Novelty, Ohio

Cooperating Activities: The Metallurgical Society of AIME; Society for Non-destructive Testing, Inc. Associations presenting technical sessions in cooperation with : Metal Powder Industries Federation; Metal Treating Institute; Ultrasonic Manufacturers' Association; Special Libraries Association—Metals Division; American Society for Testing Materials—Committee B-9; and the extensive programs of the American Society for Metals with the William Park Woodside Memorial Sessions, and Metallurgical Seminar.

SKINNER ANNOUNCES

The first major chuck development in 50 years

- Accuracy—within .001 total indicator reading.
- Repeatability, without adjustment—within .0005 total indicator reading.
- Unequalled gripping power—
- No size limitation—



THE FIRST MAJOR CHUCK DEVELOPMENT IN FIFTY YEARS

Skinner engineers have developed a new chuck that combines all the desirable features of hand and power chucks. This unique chuck will handle almost any heavy-duty chucking or milling operation.

This major chuck development is a principle utilizing combination of pinion, gear plate, screw and wedge. The lug-type pinion is turned manually or by a power wrench. A pinion engages the gear plate causing the screw to move the wedge. The action of the screw on the wedge controls the chuck jaws. The force of the wedge on the jaws holds the work with tremendous power.

LOOK AT THESE CHUCK FEATURES—

Over Tightening Protection—Because the gripping force is so great a sheer pin is used to protect the work and the chuck operating parts in the event the chuck is over tightened. The sheer pin is easily replaced.

Operator Protection—Eccentric, fail-safe mechanism locks rotation if sheer pin should break.

Higher Speeds—Self-locking mechanism prevents chuck from opening under any load or centrifugal force conditions.

Center Hole—permits bar stock chucking.

Sealed Operating Mechanism—Chip plates plus top and bottom seals keep operating mechanism free of foreign matter with no problems when chuck is in horizontal position.

Lubrication Fittings—are provided for all operating mechanisms.

Heat Treated Parts—All wearing surfaces are suitably hardened for wear resistance and strength.

Jaws—Choice of types available: Serrated, tongue and groove, etc.

Sizes—10", 12", 14", 15", 18", 21", 24", 28", 32", 36", 40", 50", 60" and above.

For more information about this radically new chuck write to us at the address below.

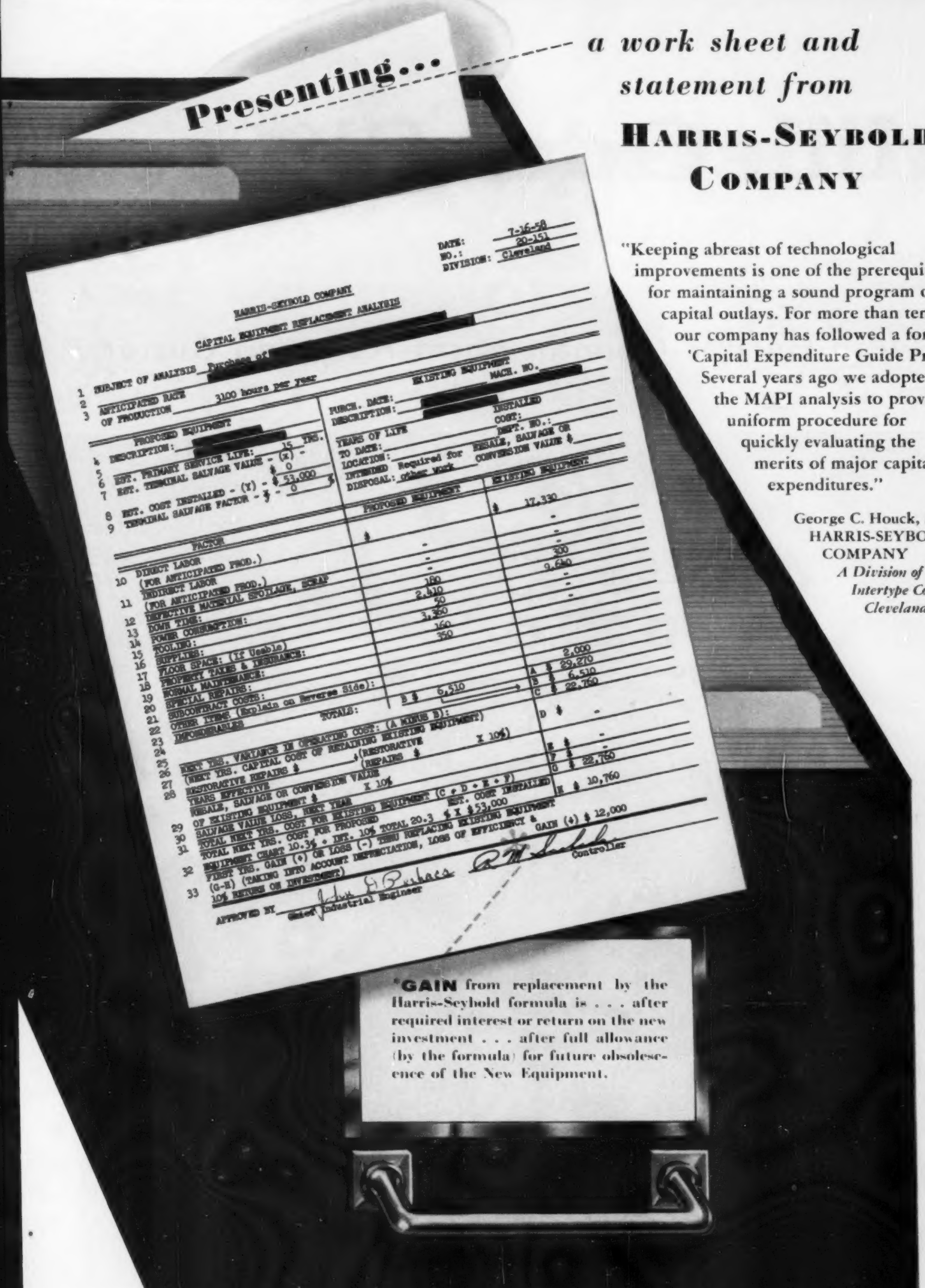
SKINNER CHUCKS ®

THE CREST OF QUALITY

SKINNERCHUCKS

THE SKINNER CHUCK COMPANY • NEW BRITAIN, CONNECTICUT

PRINTED IN U.S.A.



a work sheet and statement from

HARRIS-SEYBOLD COMPANY

"Keeping abreast of technological improvements is one of the prerequisites for maintaining a sound program on capital outlays. For more than ten years, our company has followed a formal 'Capital Expenditure Guide Program'. Several years ago we adopted the MAPI analysis to provide a uniform procedure for quickly evaluating the merits of major capital expenditures."

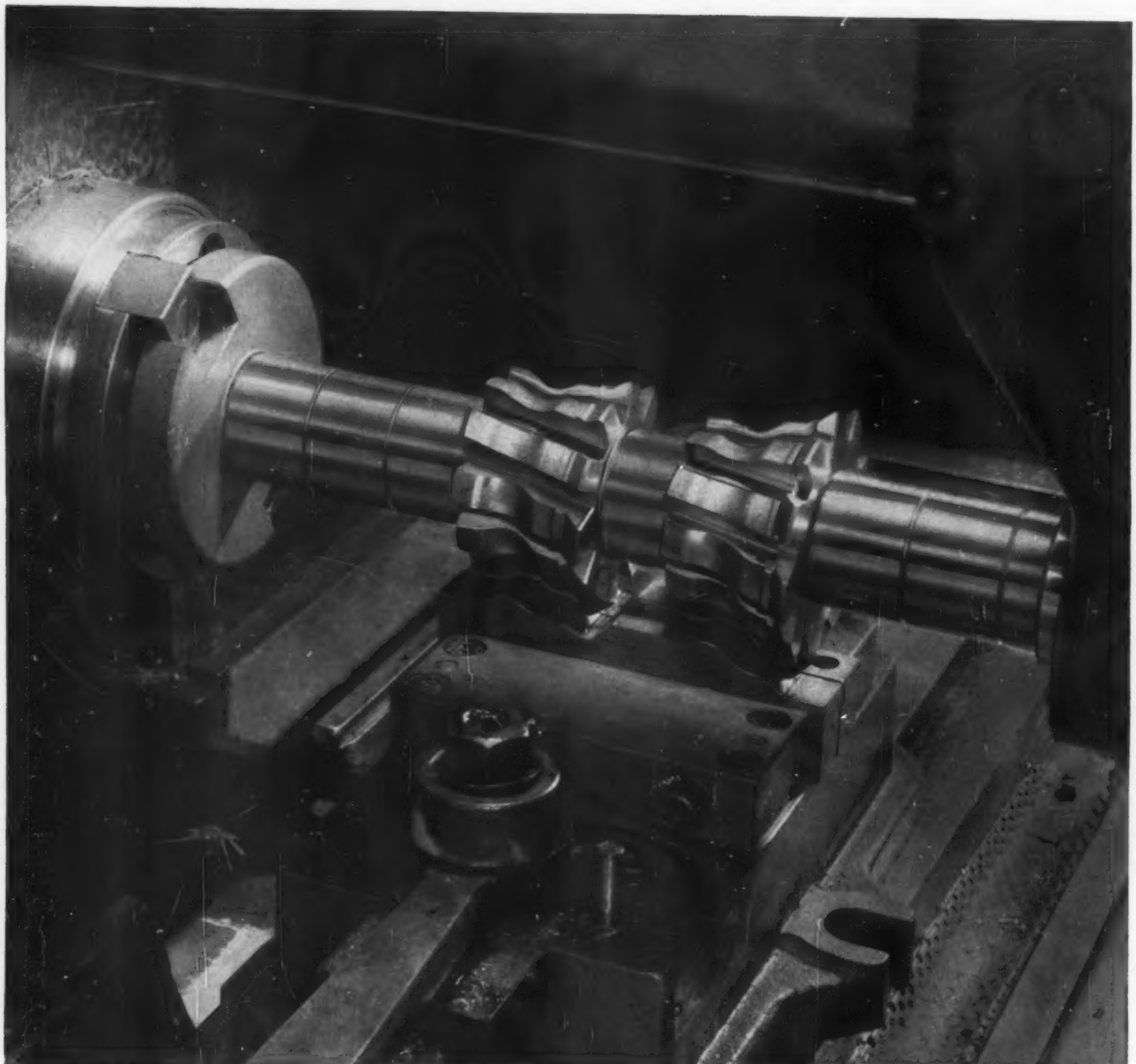
George C. Houck, *President*,
HARRIS-SEYBOLD COMPANY
A Division of Harris-Intertype Corporation
Cleveland, Ohio

Keep gathering metal-working production ideas . . . be well informed when you replace machinery.

Rockford Insert Group

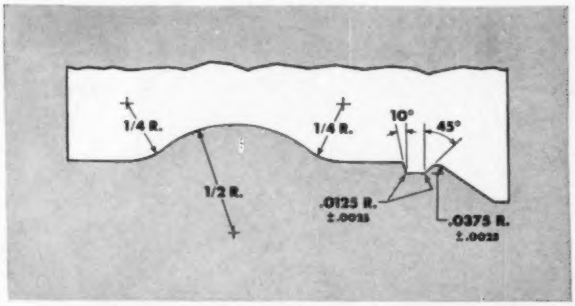
Mill Odd Shapes

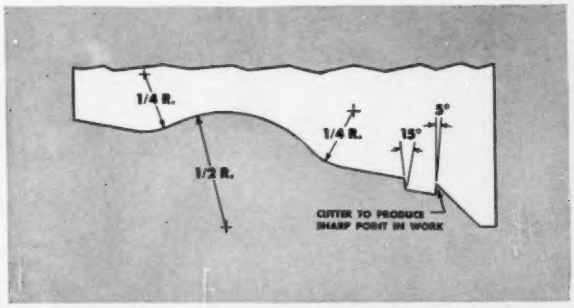
...with Barber-Colman Form-Relieved Cutters



CENTER OF MACHINE-TOOL EXCELLENCE ROCKFORD, ILLINOIS, U.S.A.

in One Operation





Two different pieceparts . . . complex forms . . . precision tolerances. All are combined in one milling operation, using Barber-Colman *unground*, form-relieved cutters.

These helical-fluted cutters are made interlocking to produce a sharp point, as shown on the drawing. Since they are of the form-relieved type, form can be maintained easily by sharpening the tooth faces.

But, the job of controlling work quality and production costs depends upon the fine points of cutter design and manufacture. In this case, for example, several difficult dimensions are held to ± .002 in. This means dimensional distortion and growth in heat-treating must be predicted accurately and compensated for in design. Sharpening, steel specifications, heat-treatment, and surface finish — all affect performance on the job. They are dependent entirely upon the capabilities of the maker.

Barber-Colman's modern new cutter plant is equipped with advanced engineering and manufacturing facilities to keep close watch on these important factors. For example, accurately ground form tools produce a smooth unground finish on the cutter teeth in the form-relieving operation. This assures maximum tool life by eliminating rough edges — a common cause of wear on the flanks. Also, because all Barber-Colman cutters are *index-sharpened*, your sharpening costs can be minimized. The job can be done on an automatic sharpener. Original tolerances are maintained easily throughout the life of the tools.

Cutter engineering service...

These five services become adjuncts to your own methods department when you submit a milling problem to Barber-Colman Company:

1. *Application engineering* — on-the-spot evaluation of milling problems by experienced tool designers.

2. *Design engineering* — highly specialized tool engineering, backed by electronic computer facilities for fast, accurate calculation of complex tooth forms.

3. *Metallurgical engineering* — specially selected steels and heat-treatment for your particular material and tool geometry.

4. *Manufacturing* — the most complete and advanced processes under one roof for producing exactly the right finish, highest accuracy, and *any* cutter style.

5. *Quality control* — optical master inspection, seven different control stations, and numerous separate inspections for individual cutters.

Barber-Colman Company

BARBER COLMAN ®

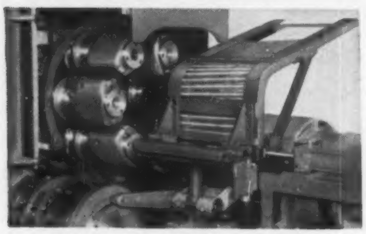
92 Loomis Street, Rockford, Illinois

Whether you want to combine operations, change processes, or just get more out of your tooling dollar, you can have a Barber-Colman field engineer at your desk for consultation by calling Rockford — TR 7-5741.

CITY OF MACHINE-TOOL SPECIALISTS ROCKFORD, ILLINOIS, U.S.A.

Second Operation


MAGAZINE LOADING


REAR LOADING MAGAZINE


HAND LOADING

A Method of Machining That Pays Off

Greenlee standard Automatic Bar Machines, adapted for second operation work, profitably machine a wide variety of parts. Long shafts or short pieces are automatically loaded into the work spindle by any of the various loading arrangements shown. Parts are loaded in one position during the machining cycle, and machined in the remaining five cross slide and end working positions. For more information, see your Greenlee Distributor.

GREENLEE STANDARD AND SPECIAL MACHINE TOOLS

- Multiple-Spindle Drilling and Tapping Machines
- Transfer-Type Processing Machines
- Die Casting Machines
- Six and Four-Spindle Automatic Bar Machines
- Hydro-Borer Precision Boring Machines

WRITE FOR CATALOG No. A-405

GREENLEE
BROS. & CO.

1744 MASON AVE.
ROCKFORD, ILL.

MATTISON
HIGH-POWERED PRECISION
GRINDING METHODS

How to stretch belt life polishing stainless to #4 finish

Mattison's diamond-head machine design keeps belts clean and cool at Atlas Steels, Limited

More production per square inch of abrasive belt—that's one of the advantages of Mattison's four-roll head design at Atlas Steels, Limited, Welland, Ontario.

The obvious reason for long belt life is longer belts—more time between cuts for cooling. Another is that these 243-in. long belts undergo four "flexes" instead of two, giving them a better chance to "break loose."

But long belt life is not the only advantage of a four-roll head. Quality is higher, too. For one thing, the belt doesn't "wrap" on the contact roll. A flatter angle of attack permits the belt to conform more closely to the uneven surfaces of the sheet. This produces a better scratch pattern and accounts for the incomparably high finish obtained on many jobs.

Specialization is another factor. In the Mattison head, one roll aligns the belt, one drives it, and another applies the pressure. The fourth is an idler and simply increases flexing action. Separation of the contacting and driving functions means motor pulsations cannot be transferred to the finish.

These features have paid off in higher quantity and easier control of quality at Atlas. Company officials estimate that not *two sheets in a million* are lost due to machine performance. A #4 finish is consistently produced on as many as 150 tons of stainless sheets per month.

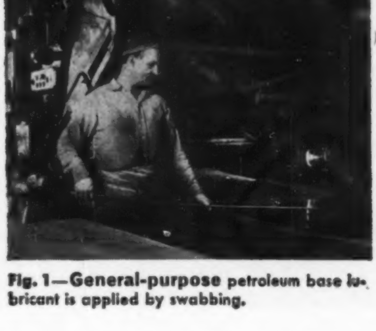


Fig. 1—General-purpose petroleum base lubricant is applied by swabbing.

Fig. 2—Belt replacement on the 50" machine requires less than five minutes' downtime. Belts are 243" long and range from 50 grit for roughing to 120 and 150 grit for finishing. Plain rubber contact roll is 35 durometer.

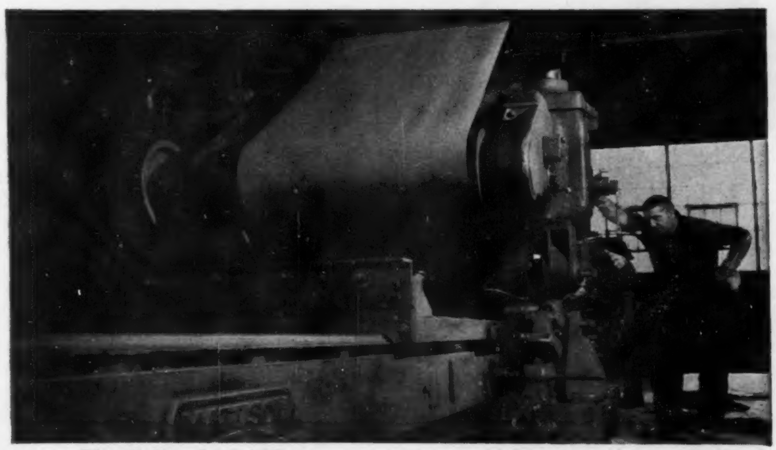


Fig. 3—Simplicity of controls means the operator can concentrate on the fine points of producing a #4 finish. Cutting speed is 3600 sfpm. Stock removal averages .003 in.

Less than 2% downtime

Two Mattison No. 455 abrasive belt grinding and polishing machines are frequently used on 24-hour production schedules and yet have recorded less than 2% downtime since 1952. In the words of one Atlas official: "Performance has been failure-free with downtime restricted to scheduled maintenance once or twice a year."

MATTISON MACHINE WORKS
Rockford, Illinois Phone 2-5521

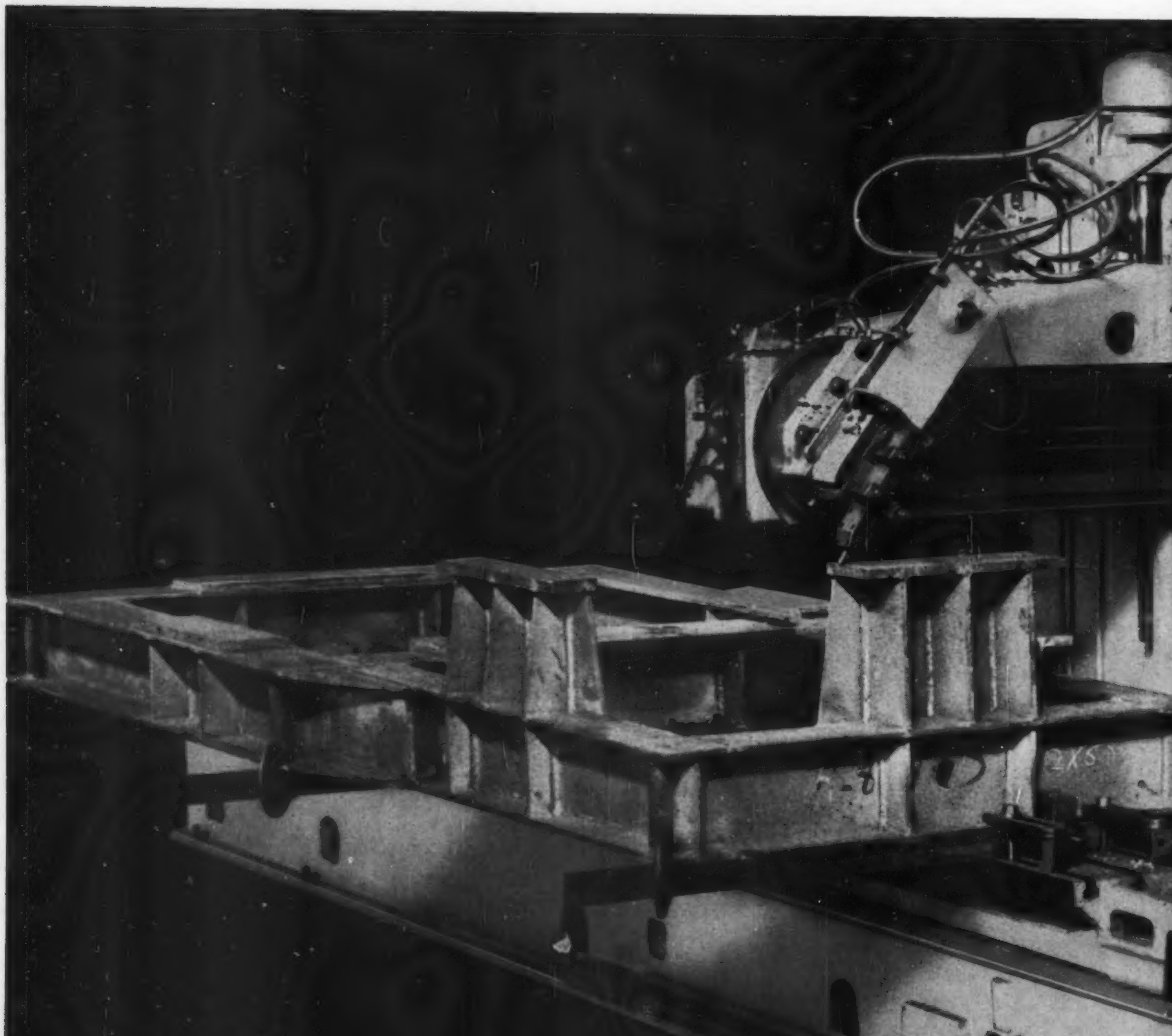
Want More Information?

Write for free literature describing the Mattison No. 455 Reciprocating Table Sheet Polisher or No. 456 Pinch Roll Grinder for single-pass work.

MATTISON MACHINE WORKS

HIGH-POWERED PRECISION SURFACE GRINDERS

Nothing does the job like a...

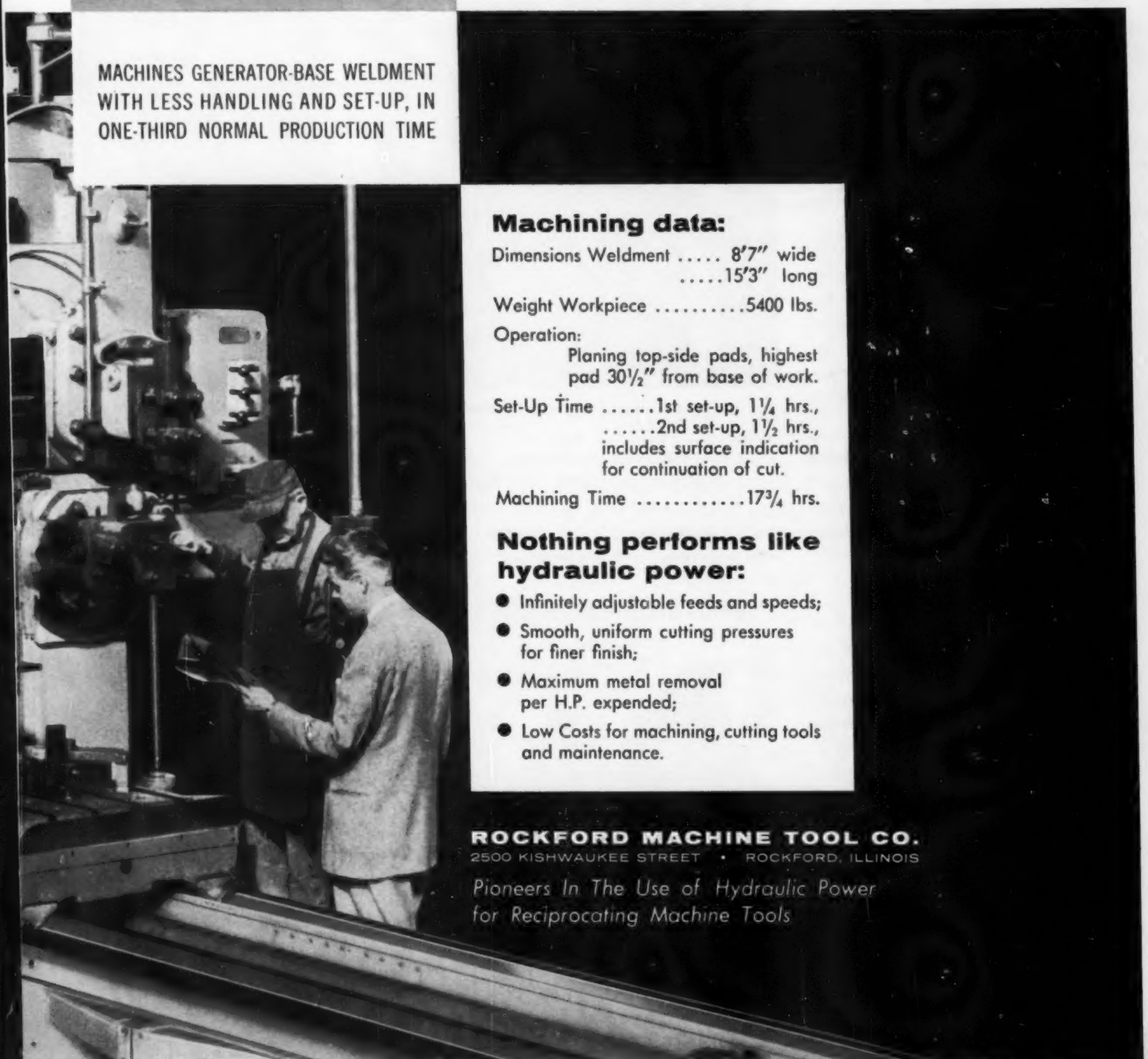


ROCKFORD

h

HYDRAULIC

... PLANER



MACHINES GENERATOR-BASE WELDMENT WITH LESS HANDLING AND SET-UP, IN ONE-THIRD NORMAL PRODUCTION TIME

Machining data:

Dimensions Weldment ..... 8'7" wide
.....15'3" long

Weight Workpiece ....5400 lbs.

Operation:
Planing top-side pads, highest pad $30\frac{1}{2}$" from base of work.

Set-Up Time ......1st set-up, $1\frac{1}{4}$ hrs.,
......2nd set-up, $1\frac{1}{2}$ hrs., includes surface indication for continuation of cut.

Machining Time ....$17\frac{3}{4}$ hrs.

Nothing performs like hydraulic power:

- Infinitely adjustable feeds and speeds;
- Smooth, uniform cutting pressures for finer finish;
- Maximum metal removal per H.P. expended;
- Low Costs for machining, cutting tools and maintenance.

ROCKFORD MACHINE TOOL CO.
2500 KISHWAUKEE STREET • ROCKFORD, ILLINOIS

Pioneers In The Use of Hydraulic Power for Reciprocating Machine Tools

FOR PRODUCTION MACHINE TOOLS IT'S ROCKFORD, ILLINOIS, U.S.A.

SUNDSTRAND *"Engineered Production"* NEWS

NOW...
it's SUNDSTRAND-ENGELBERG
for precision abrasive belt grinders

A complete range of precision abrasive belt grinders formerly built by Engelberg, Inc. is the newest addition to the expanding line of Sundstrand machines for the manufacturing industries. Sundstrand's manufacturing, engineering, and machine design experience is being applied to abrasive belt machining aimed at expanding the already broad list of operations on which the process has been applied with outstanding results. Included in the Sundstrand-Engelberg line are single and multiple head machines for deburring, flat-surfacing, sizing, fine polishing, etc., as well as centerless grinders. They offer real machining capacity going far beyond mere polishing. Multiple head machines perform all the steps from roughing to fine polishing in a single pass.

Steel chain saw bars are precision sized and finished in single pass on four-head machine. Stock removal is .005 inch.

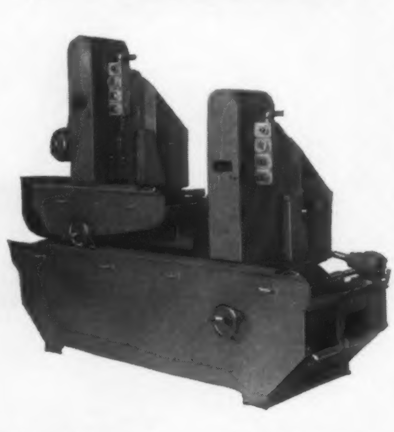
Standard machines are available with 6-, 8-, 10- or 12-inch belts and machines with 3 to 6 heads may be canted to cut obliquely to each other to produce mirror-like finishes. Cool operation with practically no chance of parts distortion due to overheating, high production rates, maximum operator safety, easy maintenance, and extreme versatility are outstanding attributes of Sundstrand-Engelberg grinders. Production workers with minimum skills can be quickly trained to handle machines in the line.

TWO-SIDE GRINDING

Extreme flexibility offered by abrasive belt grinding is illustrated by this machine. Both sides of a workpiece can be ground on this Sundstrand-Engelberg machine without special fixtures or without any handling or repositioning. Work passes under head at left, then is carried around to bottom conveyor belt for finishing second side.

Standard components are used for the bed and grinding heads, thus holding down both engineering and manufacturing costs.

Outstanding production records include one that boosted production of hardware parts by 1000%. This was done by using a specially designed rubber fixture belt with a two head machine to replace a three step process.



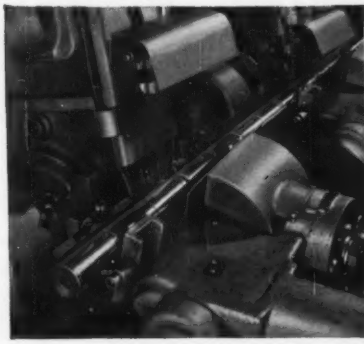
Copper-clad sheets for computer have .0002-in. removed from each side. Production jumped sixteenfold to 400 per hour.

Another machine for finishing typewriter parts has four grinding heads used in vertical and horizontal sequence to grind four sides of the part, followed by two wire brush-heads that deburr milled slots in opposite sides of the rack.

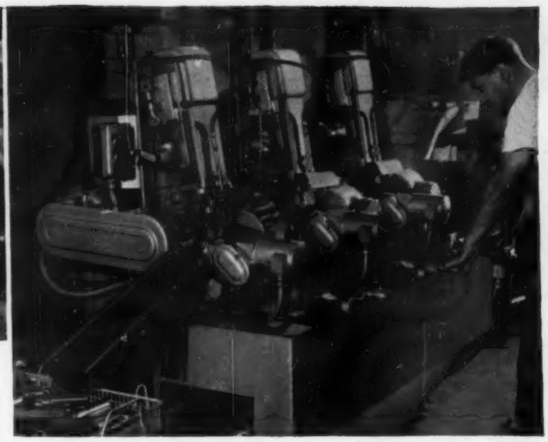
"Engineered Production" Service

SUNDSTRAND

MACHINES DESIGNED TO MEET YOUR NEEDS ROCKFORD, ILLINOIS, U.S.A.



Three-head machine has socket wrench parts fed automatically. Workpieces of varying lengths and diameters are ground to diameter tolerance within .002 inch using vibrator feeder.



CENTERLESS GRINDER

Economical, highly accurate centerless grinding of a broad array of parts is being handled on Sundstrand-Engelberg abrasive belt centerless grinders. One or more grinding heads may be used depending on the nature of the part and production rate required. The relatively simple building up of machines by adding workheads holds equipment costs low, when a multiple-head unit is necessary.

Typical parts successfully handled include motor and cylinder shafts, brass tubing, tool parts, electronic components, atomic fuel elements, etc. Surface finishes of 4 microinches and tolerances of less than .001-inch at thru-feed rates as high as 35 feet per minute have all been recorded.

Automatic feed devices are available where required by nature of work being processed. Unusual flexibility to accommodate wide range of workpiece diameters is inherent in design of the machines.

SIMPLE ADJUSTMENT, FAST CHANGEOVER

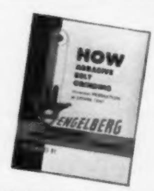
Extreme simplicity of setup and operation offers opportunity for major economies on Sundstrand-Engelberg grinders. Magnetic chucks beneath each grinding head hold work firmly on conveyor belt, depth of cut is controlled by handwheels that raise and lower grinding heads. Micrometer adjustment of head position is provided at rate of .010-inch per turn of handle.

Abrasive belt tension is easily set and adjusted for various types of belts used. Belts have long life as they provide both length and area needed to dissipate heat. Flexing of belt keeps it clean, reducing need for frequent belt changes.

Changing abrasive belt and setting tension is a simple one-man job. Once set, tension remains constant throughout operation.

Handwheels with micrometer adjustment raise and lower grinding heads for accurate setting of depth of cut.

GET MORE DATA



Additional facts about the application of abrasive belt machining are available in this booklet. *Write today for your copy, ask for bulletin 607.*

SUNDSTRAND MACHINE TOOL

DIVISION OF SUNDSTRAND CORPORATION

BELVIDERE, ILLINOIS

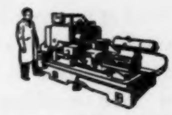
SUNDSTRAND

More facts about

SUNDSTRAND

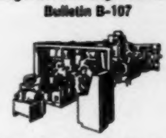
"Engineered Production"

Literature listed under various machine types has more details. Write Sundstrand for your copy today.

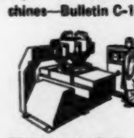


Automatic and Tracer Lathes
Bulletin A-107

Engineered Milling Production
Bulletin B-107

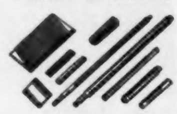


Examples of Transfer Machines—Bulletin C-107



Multiple-spindle Drilling Machines—Bulletin D-107

Internal and Rotary Surface Grinders—Bulletin E-107



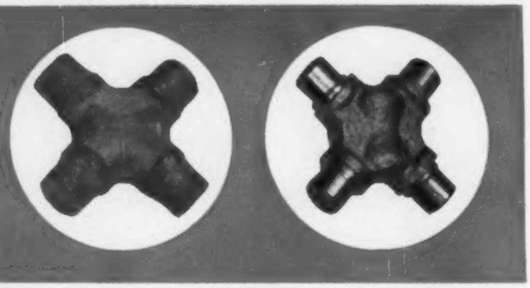
Practical Broaching Methods
Bulletin F-107

Broaching Tools
Bulletin F-107

Thread Milling
Bulletin G-107

FOR PRODUCTION MACHINE TOOLS IT'S ROCKFORD, ILLINOIS, U.S.A.

HOW TO MACHINE Universal Joint Spiders AT LOWER COST

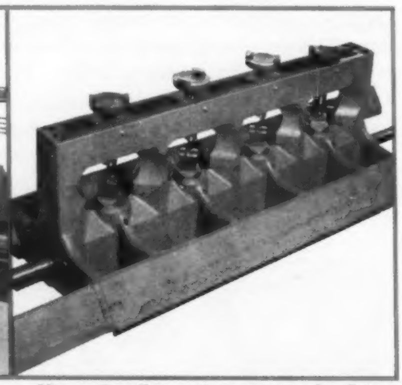


Positioning in Transfer Fixture Permits Straight-Through Operations, Conserves Space

Here is another example of how W. F. and John Barnes special machine engineering has effected a substantial reduction in production costs. By combining operations on two ends of four parts at each working station, universal joint spiders are drilled, chamfered, and hollow milled in a continuous cycle at a gross rate of 766 pieces per hour. Positioning and clamping of parts in pallet-type transfer fixtures permits straight-through operations without unclamping or re-positioning the workpieces. Rough broaching the forgings is the only preliminary operation.

A further refinement in the machine design includes power clamping of parts in fixture and automatic unclamping and unloading after machining operations are completed. Pallets are then returned to operator at the loading station. This same principle can be economically applied to a wide range of similar parts. Modifications in machine design can be made to suit individual production and cost requirements.

Barnes 17-Station Return Transfer-Type Machine processes universal joint spiders at gross production rate of 766 pieces per hour. Over-all floor space 2576 square feet.



View of pallet pusher-type transfer fixture equipped with clutch drive screws for automatic clamping and unclamping of 4 workpieces.

Builders of Better Machines Since 1872

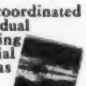
W. F. & JOHN BARNES

ASK FOR AN ANALYSIS OF YOUR PRODUCTION METHODS

For assistance with any production machining job we suggest you call in Barnes engineers and ask them to assist you. Your production problems will be closely analyzed and given expert attention. All design and engineering as well as manufacturing facilities are coordinated at Barnes to help you solve problems quickly and efficiently.

Write for Free Brochure

Describes Barnes complete 6-point coordinated machine tool building facilities. Individual bulletins are also available describing and illustrating a wide variety of special drilling, boring, and tapping machines as well as special automation equipment.



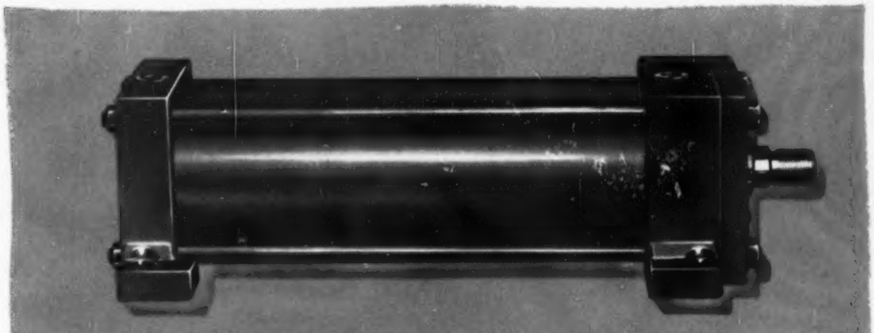
W. F. & JOHN BARNES COMPANY

402 SOUTH WATER STREET • ROCKFORD, ILLINOIS

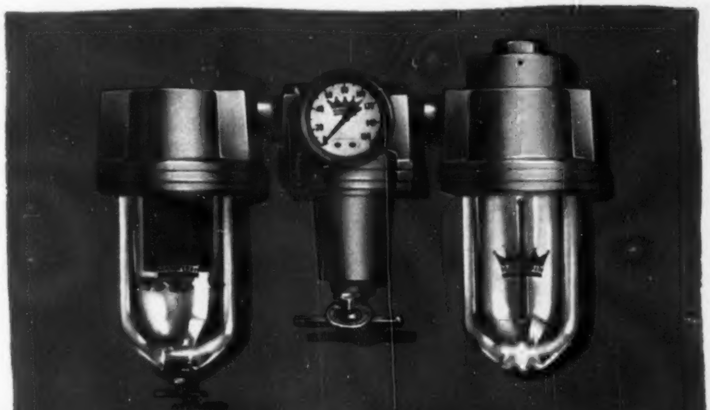
Multiple Spindle Drilling • Boring • Tapping Machines • Automatic Progress Thru Transfer-Type Machines

MACHINES DESIGNED TO MEET YOUR NEEDS ROCKFORD, ILLINOIS, U.S.A.

PARKER-HANNIFIN FLUID-SYSTEM COMPONENTS



Hannifin's 5 cylinder lines include two distinct designs of air cylinders . . . series "A" shown.



Crown "Combo" units...filters, regulators, and lubricators in any combination. Available from Hannifin or, in many cities, from Crown Distributors.

Only HANNIFIN makes all these AIR POWER COMPONENTS

Hannifin valves take many forms. This [illegible]" 4-way valve out-performs many a competing [illegible]" valve.

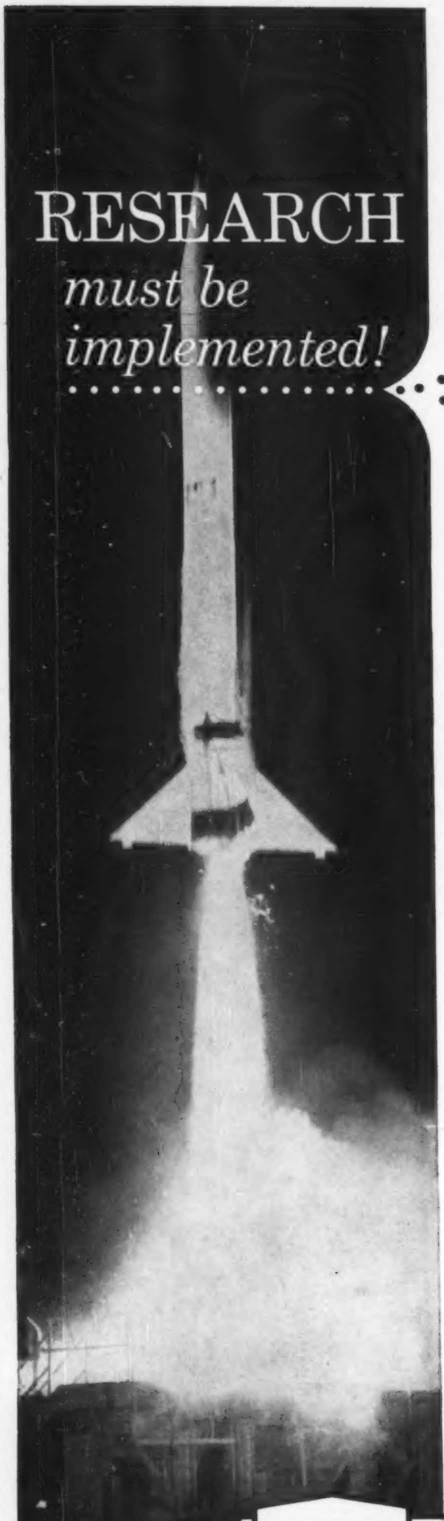
Anywhere you use compressed air to do work, Hannifin can help you. Hannifin cylinders for the "muscles". . . Hannifin air valves for any type of actuation, hand, foot, cam, solenoid, or pressure . . . the Hannifin "Crown" Line of filters, regulators, and lubricators for lasting air power efficiency . . . all are built by Hannifin to just one standard, the best.

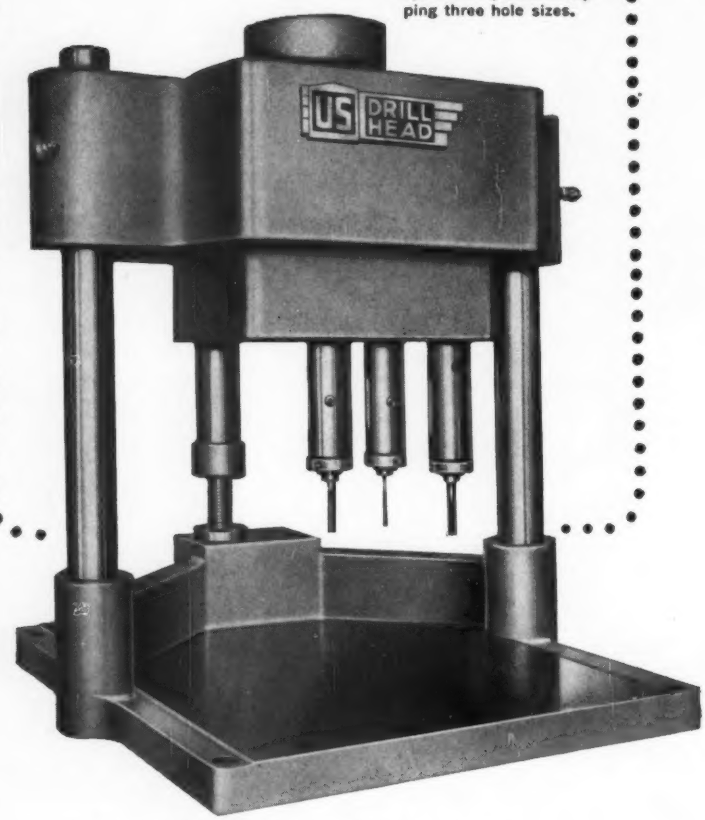
Turn to Hannifin, too, for expert help in applying air power components. A Hannifin field engineer is as close to you as your telephone, wherever you are. Write us for his address—or, he's listed in the alphabetical section of Thomas Register. It's that easy.

HANNIFIN COMPANY

505 South Wolf Road • Des Plaines, Illinois

A DIVISION OF PARKER-HANNIFIN CORPORATION





3-spindle U. S. Fixed Center Head with auxiliary lead screw tapping spindle for precision tapping three hole sizes.

. . . and, that's the business of manufacturers.

In practically all manufacturing, the most common operation is the production of holes. And, for cost-reducing production of precision multiple-hole patterns in your manufacturing— that's OUR BUSINESS!

Get low-cost
MULTIPLE-HOLE LEAD SCREW TAPPING ON A DRILL PRESS with U. S. Heads

Where precision tapping of multiple-hole patterns is required on high or low production runs, do the job on a drill press with a U. S. Master Lead Screw Head. These special fixed center heads are built with varying number of spindles and tap sizes in any one head—exact gear ratio required to each spindle as well as to master lead screw. Use on any drill press having reversing spindle.

Ask Our Engineers To Talk With Yours

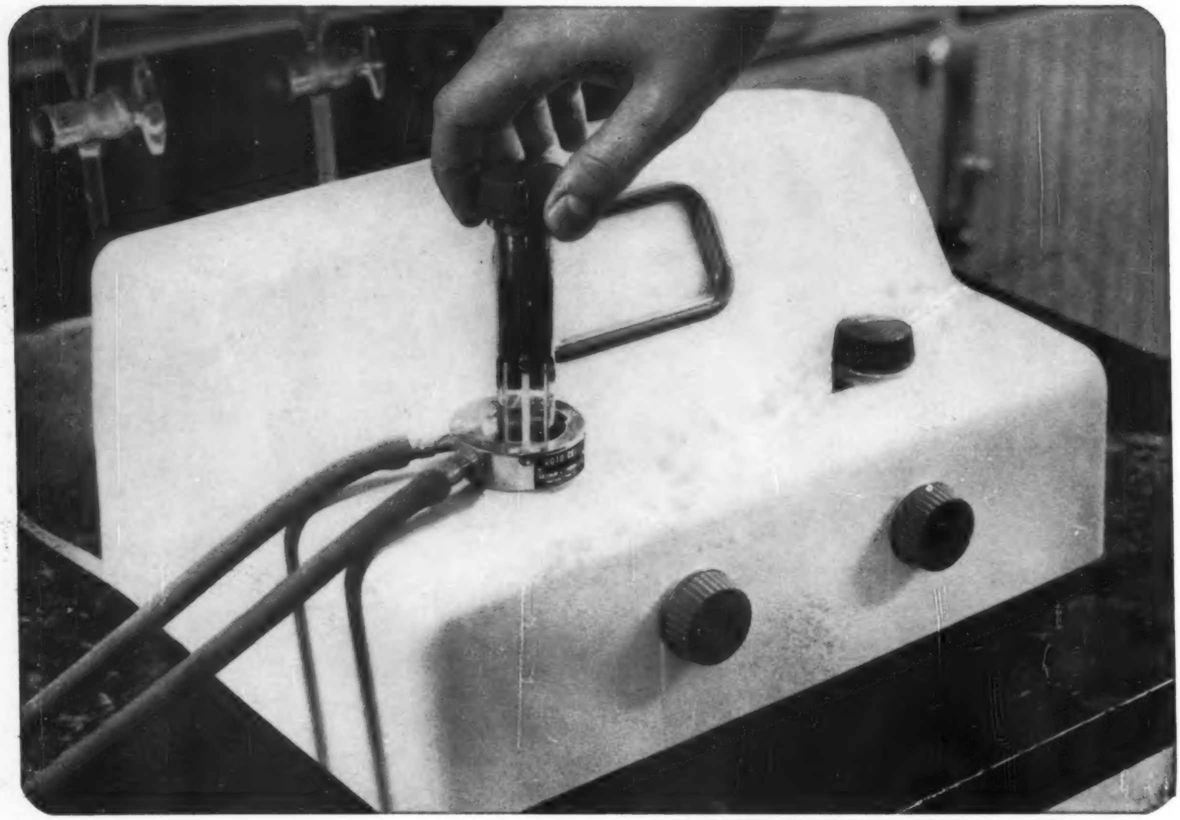
US DRILL HEAD

Adjustable and Fixed Center Multiple Drilling Heads.
Individual Lead Screw Multiple Tapping Heads.

UNITED STATES DRILL HEAD CO.

BURNS STREET • CINCINNATI 4, OHIO

Experience—the added alloy in Allegheny Ludlum tool steels



COLORIMETER (inherently extremely accurate) determines percentages of molybdenum, tungsten, cobalt and manganese in A-L tool steel to insure consistent, high quality.

Colorimeter measures exact chemical composition of Allegheny Ludlum tool steel melts

Accurate adjustment of alloys guarantees uniform heat treatment, predictable dimensional changes, reduced grinding, standardized machining operations.

Close control of molybdenum, tungsten, cobalt and manganese is at the heart of a good tool steel melt. In addition to the usual testing methods, Allegheny Ludlum's chemical laboratory checks these metals with Colorimetry because of its inherent, extreme accuracy.

On the basis of the Colorimeter's findings, it is possible to make carefully calculated furnace additions of ferro-alloys, insuring precise control over chemistry. This guarantees your receiving the *exact* analysis order after order, providing *uniformity of heat treatment, predictable dimensional changes, reduced grinding and standardized machining operations.*

WSW-7262

Colorimetry is but one step toward careful control over composition. Allegheny Ludlum also sets exacting purchasing specifications on raw materials and scrap. Quality Control checks all incoming orders to see that they conform with these specifications. Another guard toward your getting your exact specifications: each ingot bears a metal tab showing heat number.

Allegheny Ludlum stocks a complete line of tool steel sizes and grades. Call your nearest A-L representative; you'll get quick service and counsel on such problems as heat treating, machining, grade selection, etc. Or write for A-L's publication list which gives full data on the more than 125 technical publications offered. They'll make your job easier.

ALLEGHENY LUDLUM STEEL CORPORATION, Oliver Bldg., Pittsburgh 22, Pa. Address Dept. M-21

ALLEGHENY LUDLUM

Tool Steel warehouse stocks throughout the country... Check the yellow pages

every grade of tool steel... every help in using it

A NEW ERA IN RELAY LIFE AND RELIABILITY!

A-B QUALITY

THEY MAY LOOK ALIKE, BUT

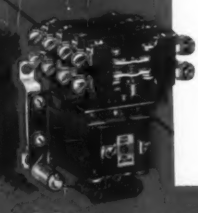
these new relays completely outmode the usual concepts of relay life and reliability.

For years the Allen-Bradley Bulletin 700 Type B and Type BX relays have been preferred for their long life and their consistent, trouble free operation. In having produced millions of these relays, we learned how to improve them. Thus, the new line of Type B and Type BX relays was designed to set a new level of performance standards.

Turn the page and see the outstanding features of these new Bulletin 700 Type B and Type BX relays. For the same price, they offer you even greater value, greater reliability.

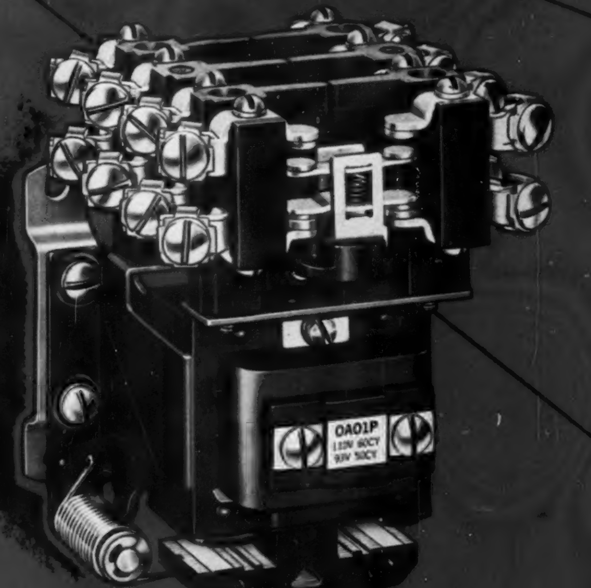
Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

old Bulletin 700
Type B-400 Relay
with 4 N.O. contacts



old Bulletin 700
Type BX-440 Relay

new Bulletin 700, Type B-220A
AC Control Relay with 2 N.O. and 2 N.C. contacts



new Bulletin 700, Type BX-440A
AC Control Relay can be wired for normally open or normally closed contacts

ALLEN-BRADLEY
Member of NEMA
QUALITY MOTOR CONTROL

7-59-MR

NEW BULLETIN 700 RELAYS

TYPE B AND TYPE BX

provide these improved features

1 New mechanical design gives *at least* 5 times greater operating life.

2 New contact motion provides 10 times greater electrical reliability.

3 Compact construction—new relays are structurally improved with no change in size.

4 Complete interchangeability. Mounting dimensions of new relays have not been changed.

5 Rugged, high efficiency cast plastic coil. New, improved coil fits *all* Bulletin 700 relays.

6 New, stronger, movable contact crossbar—fits Bulletin 700 relays now in service.

7 Improved stationary contact blocks. These new blocks can also be used on present models of the Bulletin 700 relay.

8 Increased life and reliability—*no increase in cost.* These new, improved relays are priced the same as previous Allen-Bradley models.

9 The letter A is added to the Bulletin 700 relay type number merely to distinguish the new line.

10 These new relays are Allen-Bradley's "thank you" to our many customers who have bought millions of Bulletin 700 relays over the years.

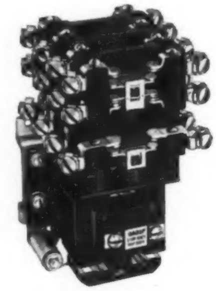
A-B QUALITY

The old Bulletin 700 relay was first placed on the market some 25 years ago. Today, millions of these relays are in daily service—all over the world.

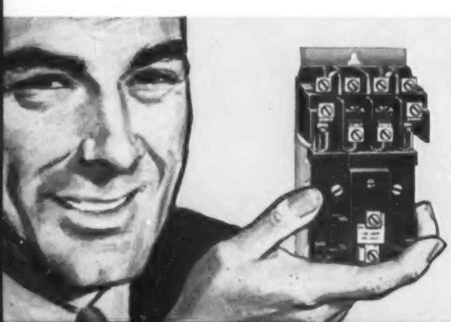
None of the old relay "values" have been lost in the new designs. Instead, these "values" have been greatly improved. The new relays feature a simplified, longer life, solenoid construction. The double break, silver alloy contacts are the same—always in perfect operating condition—without cleaning or filing. The operating coil has been greatly improved—it cannot be damaged by atmospheric conditions, no matter how severe.

No one can deny the popularity of the older Bulletin 700 relays. The new relays—with their superior features—will be an even better answer for any and all relay applications.

TYPE B, GENERAL PURPOSE
Bulletin 700, 8-pole relay. Made with 8 N. O. and no N. C., or up to 4 N. O. and 4 N. C. contacts.



TYPE BX, UNIVERSAL
Bulletin 700, 8-pole relay with both N. O. and N. C. contacts. Changeover is made by reconnecting incoming lines.



HERE IS ANOTHER REMARKABLE ADDITION TO THE ALLEN-BRADLEY RELAY LINE

It's new . . . and it's different. This unusual Bulletin 700 convertible contact relay has contacts that can be changed from normally open to normally closed operation (or vice versa)—in just moments. A screwdriver is all it takes to do the job—no additional parts are needed. Like all A-B relays, it's good for millions of trouble free operations. Watch for announcement and full details of this new convertible relay soon!

ALLEN-BRADLEY

Member of NEMA

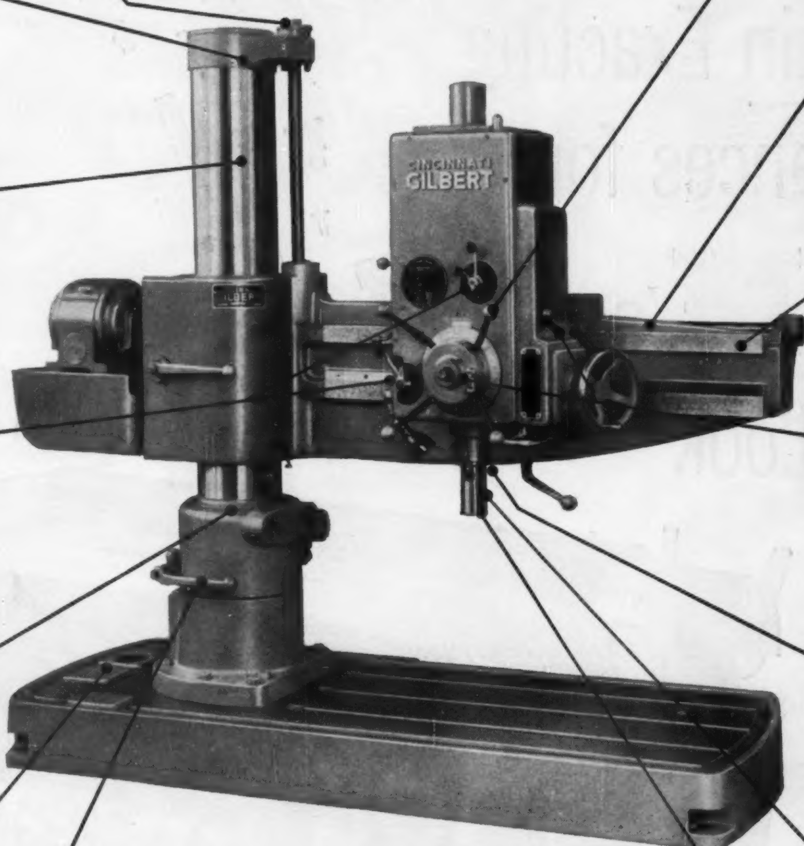
Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wisconsin
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

7-59-MR

QUALITY MOTOR CONTROL

ONLY GILBERT RADIALS
OFFER ALL THESE FEATURES

When you order a Cincinnati Gilbert radial, you get more new features per dollar than any other radial can offer. And every feature is designed to give you maximum return on your investment—in performance, productivity, and dependability.



Safety elevating nut protects both operator and machine

Weight carried on opposed Timken bearings

Hardened column available

Direct-reading speed and feed shifters; gears counterbalanced for easy shifting

Adjustable ball bearing rollers on hardened ring for maintained rigidity

Long heel on heavy base provides 360° stability

Powerful, accurate electric column clamp available

Four-lever turnstile cuts machine handling time

Balanced arm resists torsion, compression, tension forces

Head rides on anti-friction bearings; clamps three surfaces

When disengaging positive feed clutch, spindle won't drop

Full spindle support near tool, runout is less than .001"

Hardened tang slot is an exclusive Gilbert feature

You can always see the spindle; get extra use of spindle travel

And don't overlook these additional features:

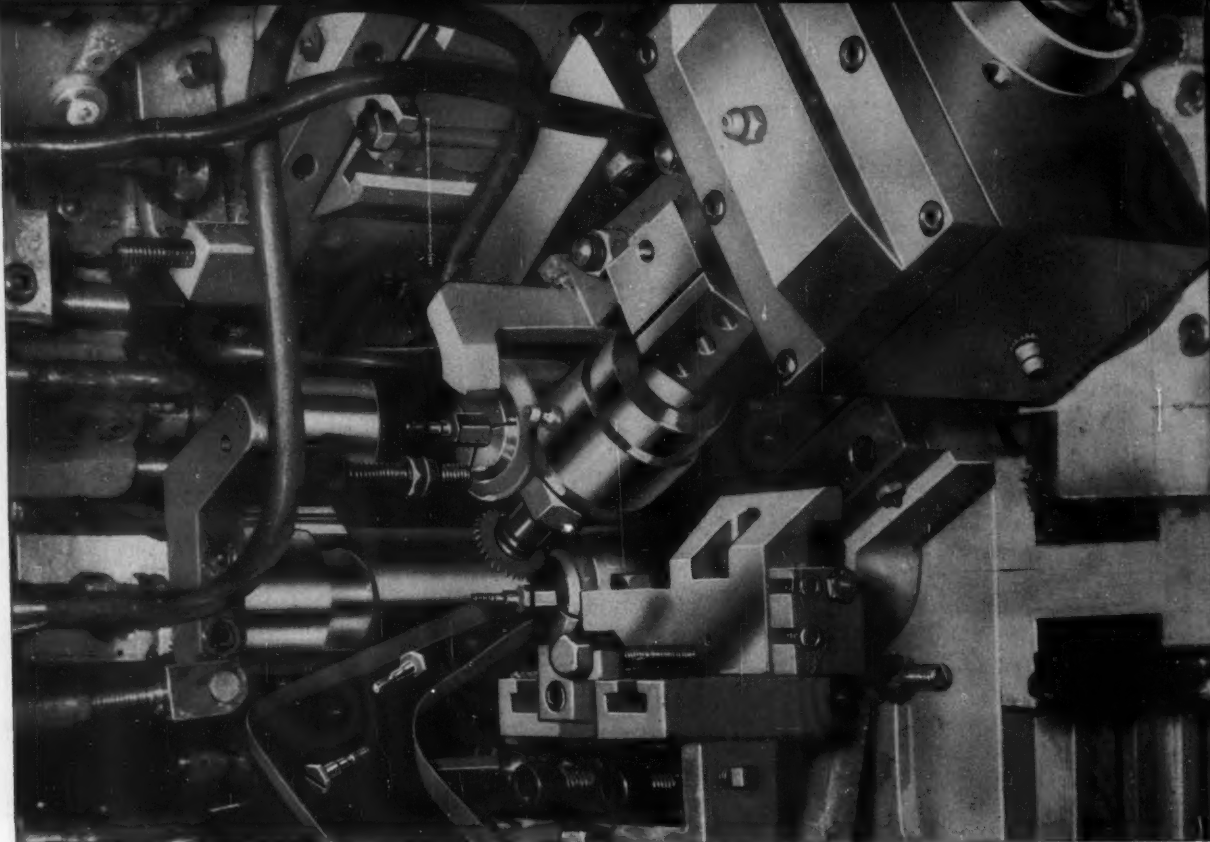
- wide range of spindle speeds for efficient tool performance;
- hardened gears throughout the machine;
- standard or special tap leads available;
- modern styling which reduces housekeeping, convinces customers that your shop is up-to-date.

Write or call for Bulletin 349.

those who buy Gilbert buy Gilbert again

THE CINCINNATI GILBERT MACHINE TOOL CO.
3346 BEEKMAN STREET, CINCINNATI 23, OHIO

For more data, circle this page number on inquiry card



Close-up of rear side of tooling zone showing slotting attachment in the 5th position.

At IBM's modern Lexington, Kentucky plant, twenty Acme-Gridley 7⁄16″ six spindle automatics are mass-producing the small to miniature parts for their sleek new electric typewriter. They help to provide IBM with greater *sustained* accuracy at lower cost than other comparable machines.

The precision components are held to closely controlled tolerances of .0005 t.i.r. These limits apply to the last piece in the run as well as the first, and consistent accuracy is maintained with less machine adjustment than ever before realized. Sustaining the closely controlled tolerances of these parts completely minimizes costly rejections during exhaustive quality control checks of the completed units. Inspection time is greatly reduced.

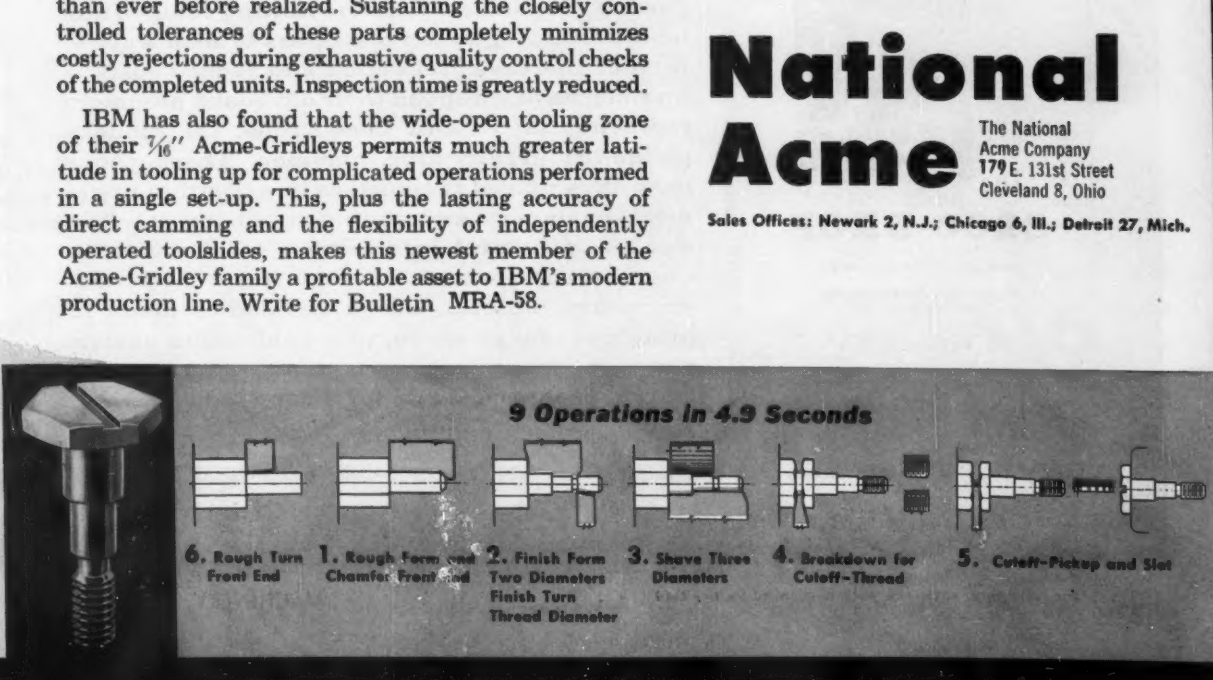
IBM has also found that the wide-open tooling zone of their 7⁄16″ Acme-Gridleys permits much greater latitude in tooling up for complicated operations performed in a single set-up. This, plus the lasting accuracy of direct camming and the flexibility of independently operated toolslides, makes this newest member of the Acme-Gridley family a profitable asset to IBM's modern production line. Write for Bulletin MRA-58.

Pioneer in Circumferential Automation

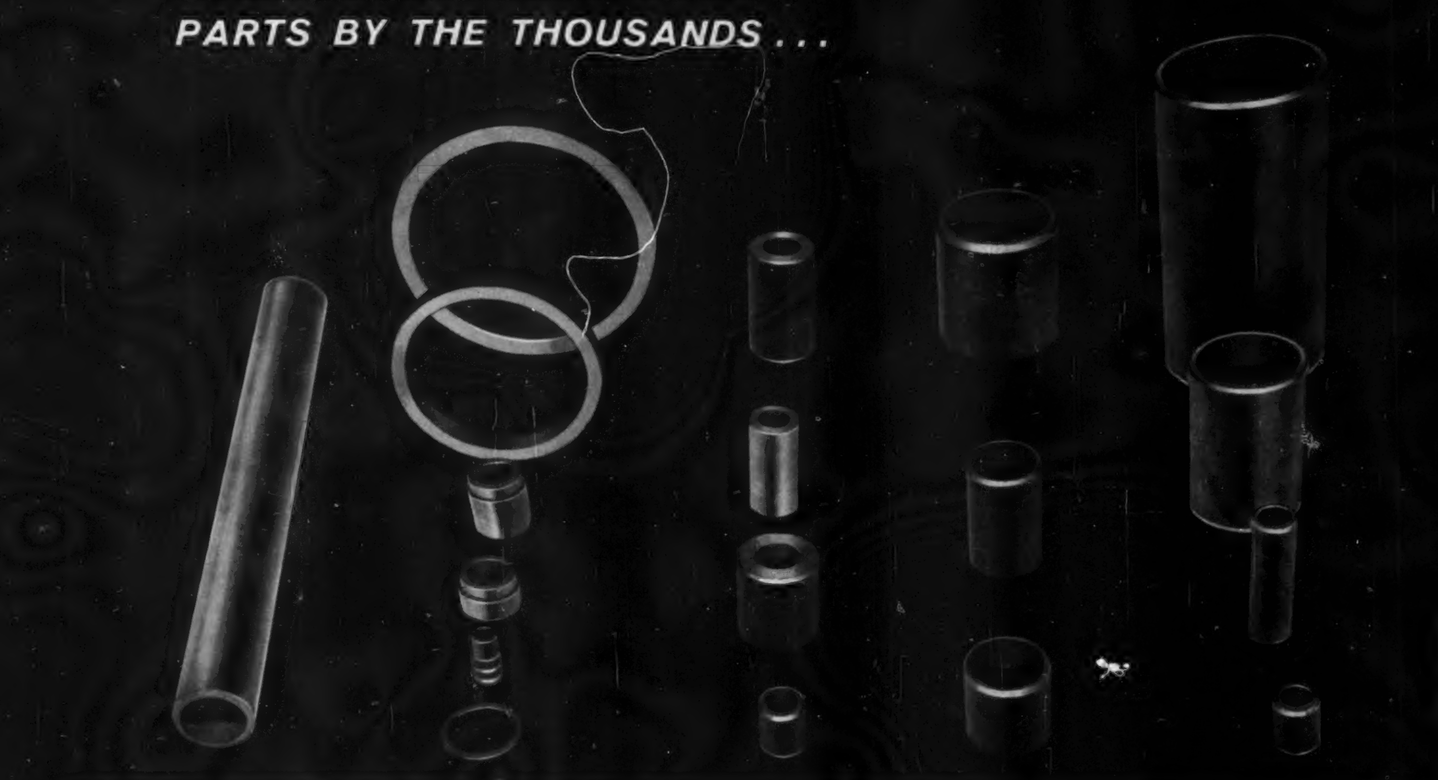
National Acme

The National Acme Company
179 E. 131st Street
Cleveland 8, Ohio

Sales Offices: Newark 2, N.J.; Chicago 6, Ill.; Detroit 27, Mich.




components such as anvils, frames and heads of many of the hammers are in need of replacement.
-21-
A Realistic Approach to Forge Shop Modernization
During the past few years, mounting competition has caused forge shop managers to seek ways to further increase production and reduce costs. A number have scrapped their old board hammers replacing them with Ceco-Drops, the modern piston-lift gravity-drop hammer. These shops have thus placed themselves in a position to get more business—and they are getting it! ● A wealth of helpful information is available in Chambersburg's new 28 page forge shop modernization bulletin. Based on studies made in prominent forge shops, this publication assists you to formulate your own step-by-step modernization program. Write for a copy today.
The CECO-DROP
and its place in forge shop modernization
CHAMBERSBURG ENGINEERING CO. · CHAMBERSBURG, PA.
CHAMBERSBURG ENGINEERING COMPANY · · CHAMBERSBURG, PA.



Left to right: Plastic tubing, rings and formed spacers, coupling blanks, heavy pipe nipple blanks, standard pipe nipple blanks.

Formed . . . Chamfered . . . Cut-Off on BARDONS & OLIVER Cutting-Off Lathes

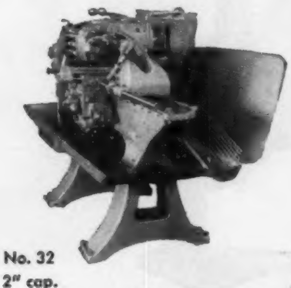
Superior Pipe Specialties Co., Chicago, reports a *ten year* profit success using Bardons & Oliver Cutting-Off Lathes.

The firm produces parts for their hydraulic equipment plus a wide variety of products on a jobbing basis.

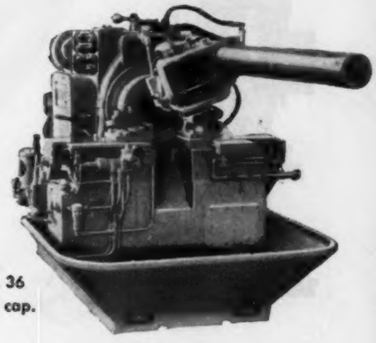
Says Mr. Youhn, Factory Superintendent: "Bardons & Oliver Cutting-Off Lathes are the *only* machines of this type that will stand up under years of hard use. We are completely satisfied with them in every respect."

As the above photograph suggests, "versatility" is the name for these Bardons & Olivers. They're unexcelled for forming, chamfering and cutting-off tubular or solid bar stock. You realize extra profits by using these outstandingly rugged machines in your plant. Available in collet capacities from 2 to 16 inches, with automatic loading and unloading equipment if desired.

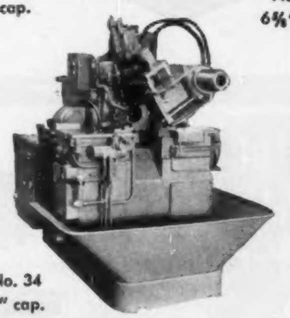
Bardons & Oliver, Inc., 1133 West 9th Street, Cleveland 13, Ohio.



No. 32
2" cap.



No. 36
6⅝" cap.



No. 34
4" cap.

OPERATING DATA FROM SUPERIOR

Typical hourly production
- No. 32 — 4000 - ½" pipe nipples chamfered & cut-off.
- No. 34 — 1082 - 2" pipe nipples chamfered & cut-off.
- No. 36 — 240 - 5" pipe nipples chamfered & cut-off.

Tolerances held on lengths: ±.002"

Average set-up time: 20 minutes

Tooling
High speed steel, carbide or roller cutter, depending on finish desired, material, operations performed and lot size.

Operators Required
2 men operate 3 machines, including setup, loading, and unloading (With automatic handling equipment 1 man can run 3 machines).

BARDONS & OLIVER

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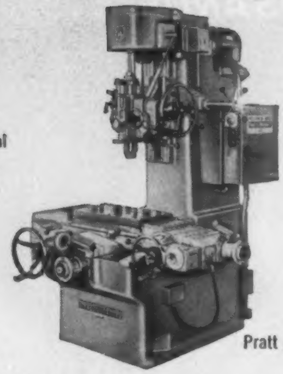
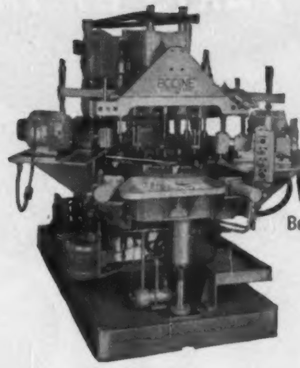
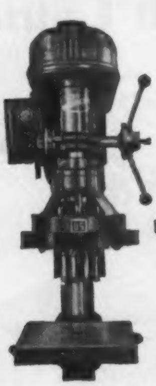
Hartford Special

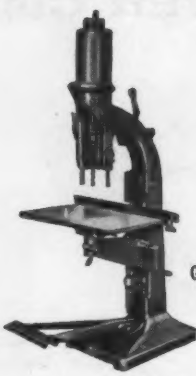

Pratt & Whitney


Bodine

18 LEADERS

stake their reputations on


U. S. Drill Head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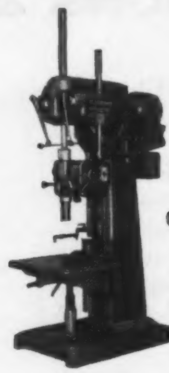
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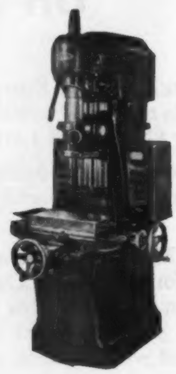
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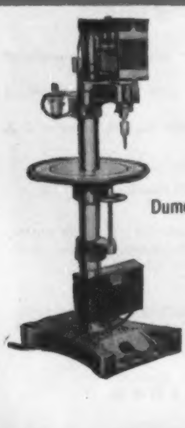
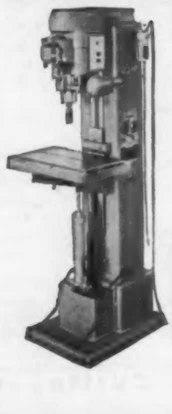

Dumore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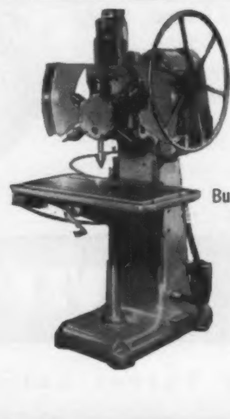
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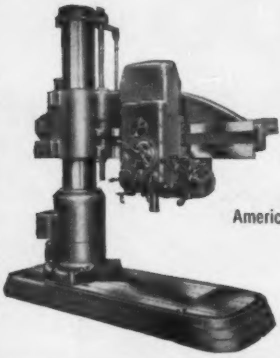
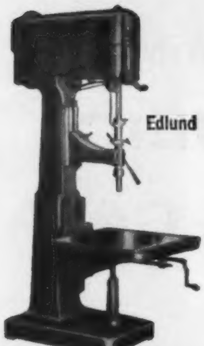
Leland-Gifford



American



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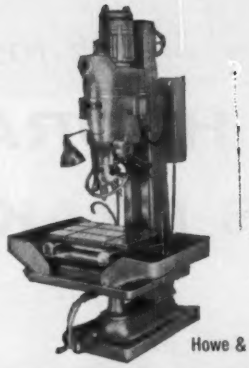

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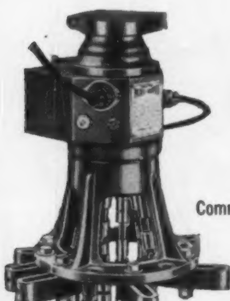
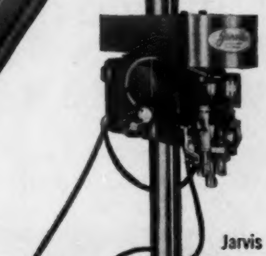


Commander



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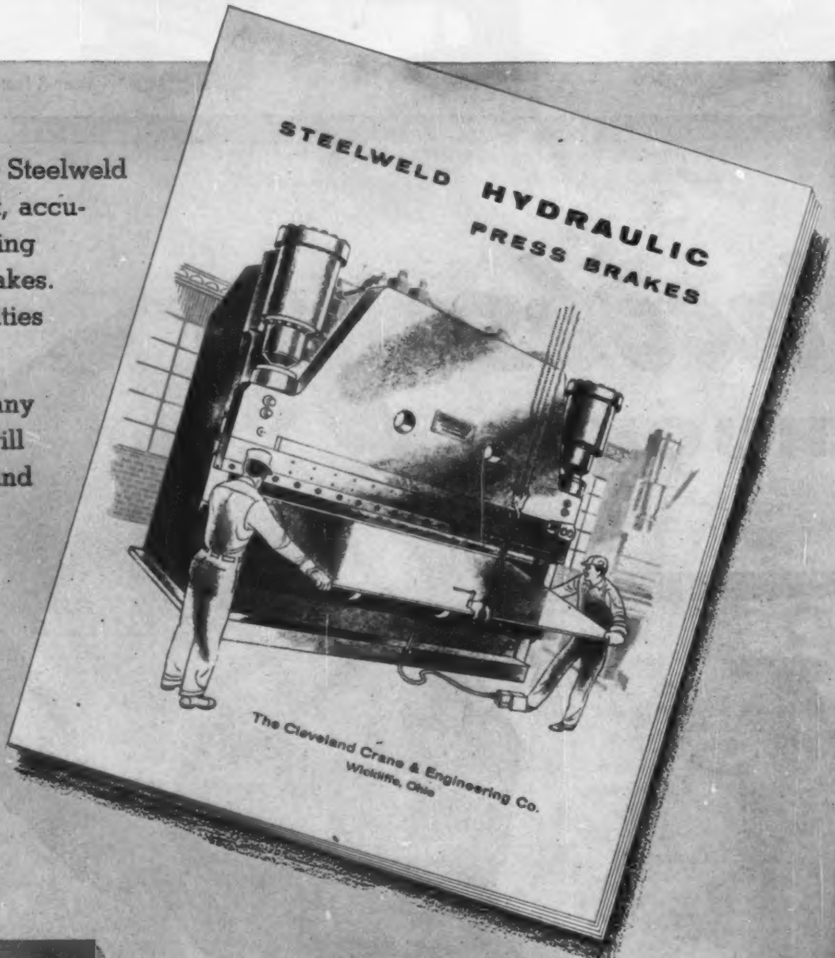

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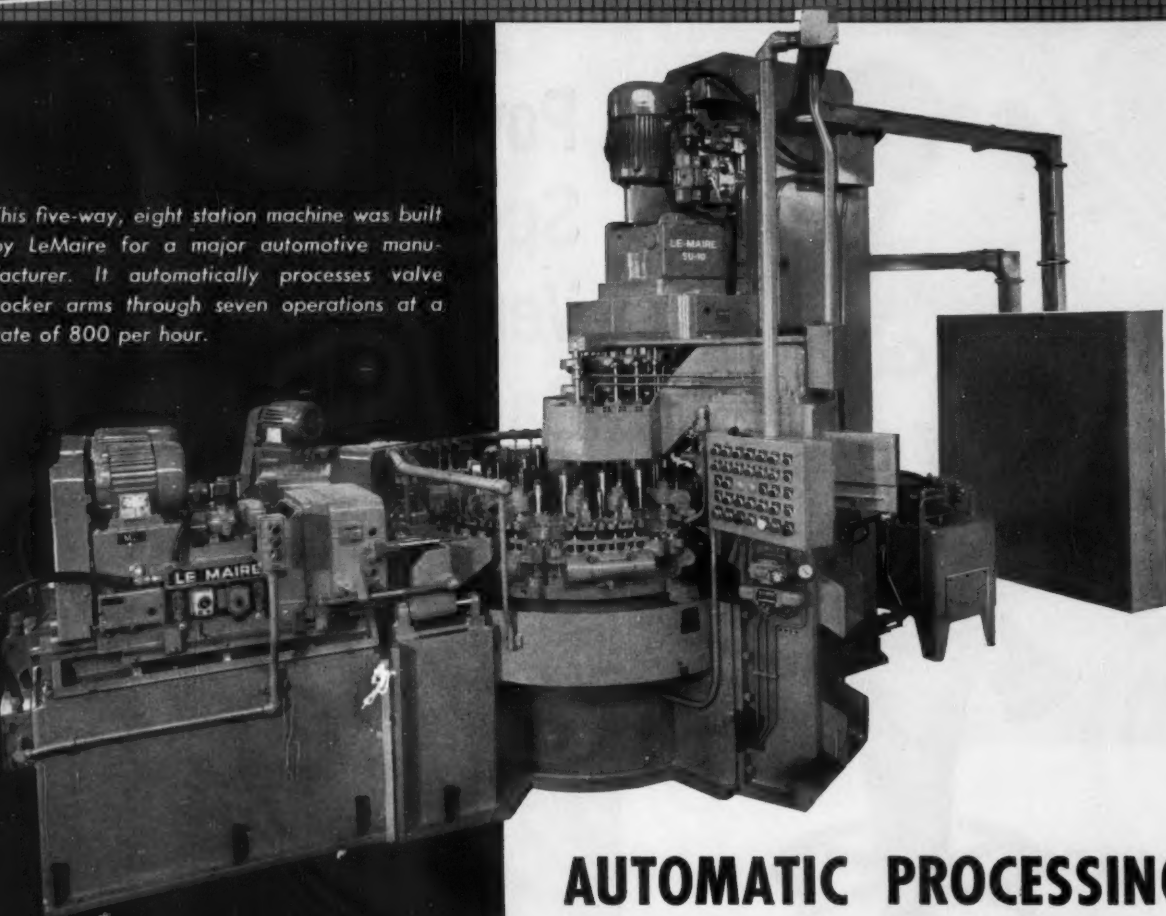
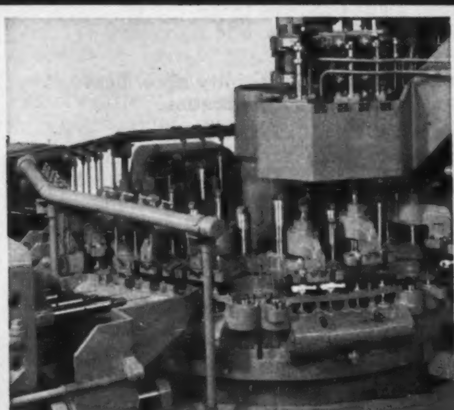
PRODUCING with LE MAIRE

This five-way, eight station machine was built by LeMaire for a major automotive manufacturer. It automatically processes valve rocker arms through seven operations at a rate of 800 per hour.





Here's a close-up of the automatic hydraulic indexing table. Work-holding fixtures have pilot bushings that register with sliding bushing plate for positive alignment.

AUTOMATIC PROCESSING

SEVEN OPERATIONS
800 PARTS PER HOUR

The variety of operations and efficiency of this machine clearly demonstrate the versatility of application inherent in LeMaire hydraulic, self-contained way-type power units. They are mounted on this machine in horizontal, vertical and angular positions to perform seven different operations. Here's the eight-station sequence of automatic operations:

(1) Manually load four valve rocker arms
(2) Drill .094″ diameter hole at 30° angle
(3) Drill 25/64″ diameter hole
(4) Countersink .469″ diameter and spot face 7/8″ diameter
(5) Tap 7/16″-20 American National Thread
(6) Chamfer .7925″ hole
(7) Finish ream .7925″/.7935″ hole
(8) Automatically unload and wash fixture

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Gisholt No. 12 Automatic Chucking Lathe

You don't have to sacrifice one advantage for another because here is an ideal combination of all in the industry's most modern high-production automatic chucking lathe.

This Gisholt No. 12 is quickly set up to save you time and money on continuous, high-speed production or a wide variety of parts in small lots. It can take practically any part up to 16½" in diameter.

COST-CUTTING VERSATILITY. With 420 spindle speeds ranging from 40 to 2600 r.p.m. and an infinite selection of feeds, it gives you top efficiency in all phases of every job—cutting costs all the way.

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GREATER POWER, GREATER ACCURACY. Constant h.p. motor (up to 40 h.p.) on the No. 12 takes full advantage of today's most advanced cutting tools and tooling techniques. Greater weight and rigidity allow heaviest cuts at punishing speeds without vibration.

COMPLETE RANGE OF ACCESSORIES. Front, rear, auxiliary and overhead slides can be used; angular cuts are easily made; JETracers can be used with greatest efficiency. Automation can be incorporated—from simple loading and unloading to gaging and sorting of finished pieces.

Your Gisholt Representative will gladly show you how the No. 12 Automatic Chucking Lathe will pay for itself in your plant. Call him, or write for Bulletin 1213.

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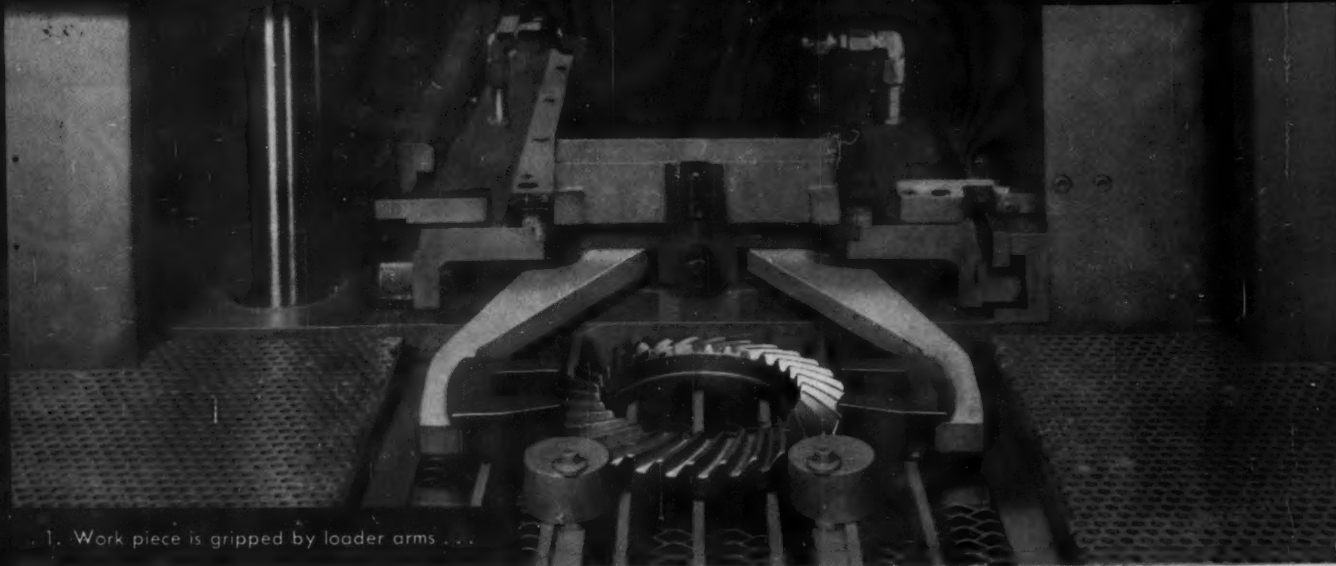


1. Work piece is gripped by loader arms . . .

2. . . . which move piece to quenching die . . .

3. . . . where controlled flexing relieves strains before quenching.

New Gleason machine quenches gears *3 times faster* with minimum distortion

The unique, fully automatic method incorporated into the new Gleason No. 117 Quenching Machine makes it possible to quench gears and other parts faster than ever before without significant distortion.

The machine discharges a piece every 30 seconds; accommodates 17 pieces in process at one time.

Automatic handling. Once a part is deposited at the front of the machine, the No. 117 positions it on a quenching die and then clamps, flexes, and quenches it. Initial quenching takes only about ten seconds.

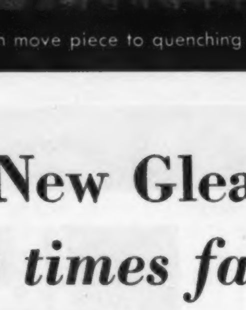
When the part cools past the critical hardening temperature, it is released from the dies. Still immersed in oil, the part then cools completely as it travels on a conveyor to the unload chute. As soon as part is released from dies, the machine is ready to receive another work piece.

Flexing before quenching. Each hot part is flexed between the dies to relieve internal stresses. Rate and number of flexes are easily preset. Hydraulic pressure produces positive diaphragming action.

Pulsing. All pressure on the work is pulsed momentarily throughout the die-quench. This permits work to contract without strain. During the die-quench, oil flows uniformly over and around the part.

Faster production. You can speed up production materially with the Gleason No. 117 Quenching Machine. It handles ring gears and cylindrical parts up to 10½″ in diameter and 8″ high. You can connect it with any conventional furnace so that parts are automatically fed to the quenching press. Push-button controls and timers are adjustable and easy to set. Dies can be changed quickly and easily.

Gleason engineers are ready to help you step up productivity with this new machine. For complete details, write for bulletin.



Gleason No. 117 Quenching Machine

GLEASON WORKS

1000 UNIVERSITY AVE., ROCHESTER 3, N.Y.

- Foreign Trade Mission Bids Out
- MAPI Favors Boggs Bill
- Overseas Dangers Cited
- Washington Briefs

Keeping up with Washington

Loring F. Overman

THE NEED for more complex and more expensive production equipment is indicated by research probing more deeply into the requirements of tomorrow's missile, aircraft, and spacecraft industries. The tip-off comes from Rear Admiral John E. Clark, deputy director of the Advanced Research Projects Agency. Advancement of U. S. military technology now depends, he said, on large-scale, long-term research programs which "proceed confidently and quite generously."

Such programs, the ARPA director predicted, will cause a chain reaction resulting in improved fuels, improved materials to facilitate their use, and improved production equipment. This viewpoint is echoed by the Aerospace Industries Association, which notes that "automation and numerical control of tools must be adopted on a wide scale. Present testing equipment is not sensitive enough for future needs. New standards of data evaluation and quality control must be developed."

Foreign Trade Mission Bids Out

The Commerce Department is inviting American business firms to make use of U. S. Trade Missions as a source of information and contacts for export and import trade. Members of several missions are seeking information as to the capabilities of U. S. firms.

Starting in September and ending on October 25, missions will be touring Italy, Sicily, Yugoslavia, Peru, and Ecuador. Missions to the first three countries will be concerned primarily with industrial development, methods of attracting investments, and patent licensing techniques. The Southern Hemisphere missions will discuss general trade, industrial development, licensing, investment, finance, and tourism.

MAPI Favors Boggs Bill

Increasing concern by machinery manufacturers over the question of overseas business was voiced during recent hearings on the Boggs Bill (HR 5), before the House Ways and Means Committee. Stated purpose of the bill—to promote American industry abroad by enacting tax laws enabling private investors to do business in foreign countries on a basis competitive with investors of other countries.

The Treasury Department has been generally favorable, but has held that tax concessions should promote the flow of capital to less-developed countries. Commerce and State Departments concurred. Witnesses representing business contended that a workable formula including prosperous or well-developed areas would provide working capital for the undeveloped areas. Charles W. Stewart, president of Machinery and Allied Products Institute, appeared to speak in favor of the broader concept. Representing MAPI, he presented an eleven-point set of recommendations. Business generally has testified that the Boggs Bill would encourage overseas investment to such an extent that much direct foreign aid could be ended.

Overseas Dangers Cited

Testifying before the Senate Banking Subcommittee on International Finance, another spokesman for the machine tool industry pointed out that there are two sides to the coin. Ralph R. Cross, executive vice-president, The Cross Co., Detroit, explained why his company has decided to establish a plant in Europe to manufacture automation machinery for industrial plants.

He observed that his concern has a dual interest in the flow of U. S. capital abroad "because (1) our customers are metalworking plants and, if American industry is going to reinvest its capital overseas, then we are going to find that our major customers have shifted from the Midwest part of the United States to Europe, South America, or wherever they go, and (2) our second interest in the problem is to reinvest our own capital where we can earn maximum return for our stockholders."

Mr. Cross said he does not anticipate a stampede of metalworking firms to set up plants in Europe, but that some might be able to produce more cheaply there. Conceding that some investment of U. S. dollars overseas can be beneficial, he warned that "if the movement is to displace American production facilities, then we must be prepared for some major changes in Government and industry."

Washington Briefs

Three-year extension of the Renegotiation Act of 1951 (until June 30, 1962) was approved by the President when he signed HR 7086. The new law provides a five-year carry-forward for losses of negotiated business, and for extensive investigations of Defense Department procurement methods.

Bureau of Standards notes that some portions of the precision machine tool and instrument industries may be affected by a recent change in definitions of the units, "yards" and "pound." The changes, which will not affect ordinary commerce, reduce the yard, as defined in 1893, by two parts in one million. New value for the pound, defined in kilograms, is smaller than the 1894 pound by one part in 10 million.

Recently produced forging for Alcoa's 50,000-ton press, operated under the Air Force heavy-press program, is an 80-inch diameter, saucer-shaped "heat sink" squeezed from a single billet of beryllium. The forging will form the outside covering of the floor of the space capsule on the manned Project Mercury.

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Not Many Steaks!

AN AMUSING STORY that recently appeared in print related to an incident which occurred on an express train running from Madrid, Spain, to Paris, France. An irate patron of the dining car complained bitterly, not once, but several times, to his waiter concerning the inferior quality of the steak served to him.

The waiter, a rather haughty Castilian, paid scant attention to the derogatory remarks. Finally, however, when his indifferent attitude failed to quiet the complainant, he sarcastically remarked that there was a suggestion box at one end of the car for customers' comments. Thereupon the indignant diner walked to the suggestion box and stuffed his steak through the slot.

Fortunately, the suggestion boxes found throughout our industrial plants are accorded far greater respect. Thousands of useful ideas are placed in them every year which have led to greater efficiency in many shops.

Suggestion-box programs are based on the assumption that the employes who are actually doing the work in a plant are in the best possible position to suggest methods of performing their duties more easily or better so far as work quality and production speed are concerned. Companies that have promoted the use of suggestion boxes have adopted many ideas that have worked out to the advantage of both the companies and their employes.

Pratt & Whitney Aircraft is a strong proponent of suggestion boxes as a result of the satisfactory operation of its present program over a period of twelve years. From March 1947 through January of this year, 91,938 suggestions were submitted. Of these, 17,433 suggestions were adopted and $613,673 paid out as awards. In 1958 alone, $67,417 was paid out for 1689 accepted suggestions. In a recent month, 160 awards were made for a total of $7000. The prizes ranged from $2365 down to $3.75.

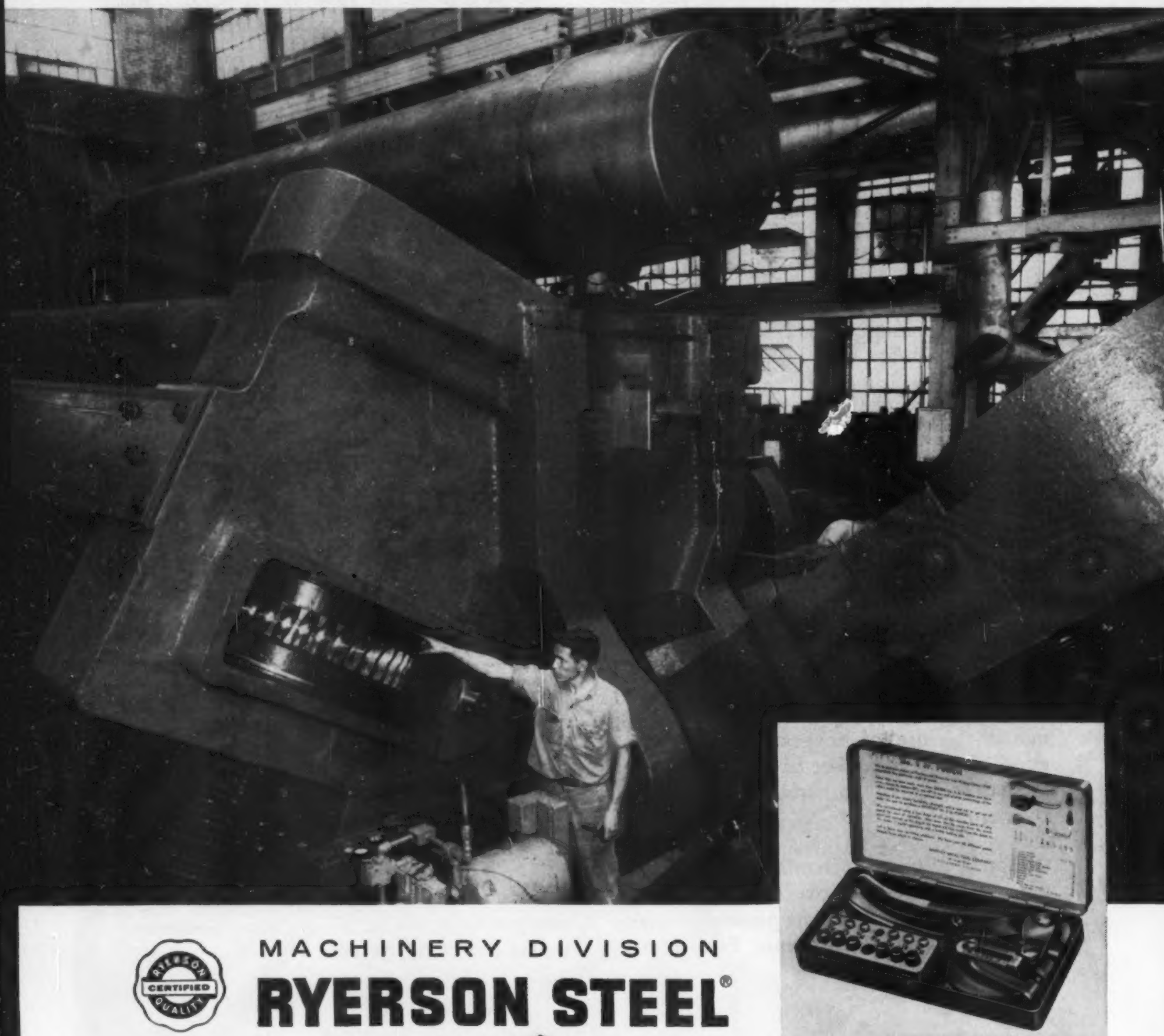
In addition to the material advantages accrued to employers and employes by the use of a suggestion-box program, there are benefits that are not immediately obvious. For one thing, suggestion boxes provide a means of communication between subordinate workers and plant executives that would not exist otherwise. Whether or not an employe's suggestion is acceptable does not matter too much. At least the employe has the opportunity of bringing his ideas to an executive level where they will receive serious consideration. That, alone, fosters the feeling in the mind of the employe that he is of importance in the company organization and that he can have direct communication with management.

The public relations department at Pratt & Whitney Aircraft has found that local newspapers want to publish items about suggestion-award winners. This information makes popular reading material. Press releases are, therefore, issued throughout the state of Connecticut. Award winners are also featured in the company publication.

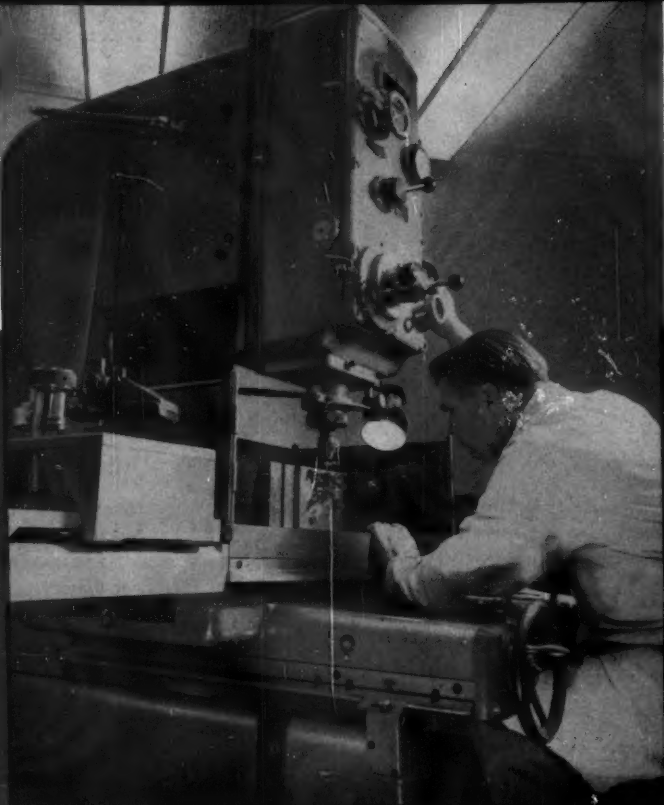
The development of good will—the goal of personnel relations departments—is therefore a by-product of a well-run suggestion program. And remember, many employe suggestions have real merit—not many unsavory steaks go into the boxes!

Charles O. Herb

EDITOR



HAROLD W. BREDIN
Associate Editor



Electronic components used in the propagation of microwaves involve some precise and unusual machining operations. Production methods employed at one of today's foremost electronic-research laboratories are described in this article

HIGH FREQUENCY— HIGH PRECISION

RECENT INNOVATIONS in radio-communication and control systems have prompted designers of electronic equipment to require a greater variety of mechanically precise parts. For optimum performance, some of these devices use components that only a few years ago would have taxed the production facility of available machine tools. Miniaturization of electro-mechanical instruments for aircraft and missiles have also emphasized the growing importance of close-tolerance machining to many products of the electronic industry.

These trends are particularly evident at ITT Laboratories, Nutley, N. J., a division of the International Telephone & Telegraph Corporation. As a basic research and development center this organization has, in effect, been responsible for many notable advances in electronics. They range from Dr. Lee De Forest's perfection of the vacuum tube oscillator in 1912 to many widely diversified recent achievements. These include airborne guidance systems for the missiles Talos and Terrier and an electronic spectroanalyzer that completes otherwise tedious and time-consuming chemical analyses in a matter of only a few minutes.

Production of a special silicon diode for over-the-horizon microwave radio links is an outstanding example of how modern techniques have simplified an otherwise difficult machining task. The special diode, seen in Fig. 1, is cut from silicon grown into single-crystal form at the laboratories. Consistent with the usual practice for producing other semiconductor devices at

Fig. 1. This special diode for amplifying microwaves is machined from single-crystal silicon. A projection, 0.002 inch high by 0.003 inch in diameter, is functionally the most important portion of the work-piece.

the company, the silicon crystal is first sliced into discs of appropriate thickness. This is done on a precision wafering machine made by the Micromech Mfg. Corporation, equipped with a 0.015-inch-thick diamond saw. Wafer thicknesses range from 0.005 to 0.020 inch. The faces of the discs are then lapped parallel on a Dallons lapping machine, the aluminum-oxide abrasive used having an average particle size of 22 microns.

Next, the discs are ultrasonically diced into pieces having the required 1/16-inch diameter of the diode. This is accomplished on the Raytheon equipment seen in Fig. 2. A typical ultrasonic cutting tool used for dicing is shown at the right in Fig. 2, and in Fig. 3. These cutters are made by silver-brazing together a hexagon-shaped bundle of hypodermic-needle tubing several inches long. The bundles are then cut into half-inch sections and brazed as needed to a Monel tool cone. Hexagon-shaped bundles are used to obtain the greatest number of diodes from a silicon disc. In operation, the machine vibrates the cutting tool at the rate of 25,000 cycles per second and an abrasive slurry is supplied through flexible hoses to the work area. The work is slowly fed vertically into the tool.

After dicing, the special microwave diode is completed by ultrasonically cutting one face to produce a centrally located 0.003-inch diameter by 0.002-inch-high projection. The tool employed consists of a soft-steel cutting tip attached by a threaded shank to a standard Monel tool cone. The cutting end of the tip is turned to a diameter just slightly greater than that of the diode and a 0.003-inch diameter hole is drilled in the center of this face. Thus, during the ultrasonic cutting, all of the material from the face of the work-piece is removed to a depth of 0.002 inch, except for


Fig. 2. Equipment employed to ultrasonically machine the special silicon diode and other microwave components. Cutting tool used for dicing is seen at right.

that area immediately below, the 0.003-inch diameter hole. This unaffected portion enters the hole to a depth of 0.002 inch to form the required projection on the diode. The diodes are inspected by microscope. In Fig. 2, the special tool and work-holding fixture are shown set up in the ultrasonic machine for this operation. The slurry used contains an aluminum-oxide abrasive having an average particle size of 5 microns.

Since the diameter of the tool tip is greater than that of the silicon work-piece, the cutting action causes steps to form in the tip. These are removed by lapping the tool after every ten pieces. Dicing tools are also dressed by lapping, but normally not before at least fifty cuts have been made.

Another unusually shaped part is seen in Fig. 4. Made of silicon 0.040 inch thick, this component is readily produced by ultrasonic machining. The tip of the cutting tool is simply formed to cut the outline of the work-piece.

Ultrasonic techniques are also employed in the making of traveling wave tubes—but for another purpose—cleaning. These tubes, vital to microwave radio links, require soldering. The flux used, if allowed to remain on the part, would eventually cause corrosion, and damage to the tube. To prevent this, it is removed by ultrasonic cleaning. The parts are first placed in a container of alcohol or acetone. This container, in turn, is supported partially immersed in a Sonogen cleaning tank (Fig. 5) filled with a special detergent and water mixture. The surfaces of the two fluids are maintained at approximately the same height. A separate power generator of the same manufacture supplies a 40,000-cycle-per-second alternating current to a transducer in the base of the tank.

In operation, the ultrasonic vibrations emanating from the transducer are successively transmitted through the stainless-steel tank bottom, the detergent mixture, and the part container to the cleaning agent and the parts. Ultrasonic cleaning of a number of 1/4-inch-diameter by 20-inch-long ceramic rods is illustrated in Fig. 5. These rods are used to support the elements of traveling wave tubes and must be thoroughly cleaned before installation. To complete the cleaning, a second processing is required with the rods reversed in the container. The cleaning agent is electronic-grade acetone and the time

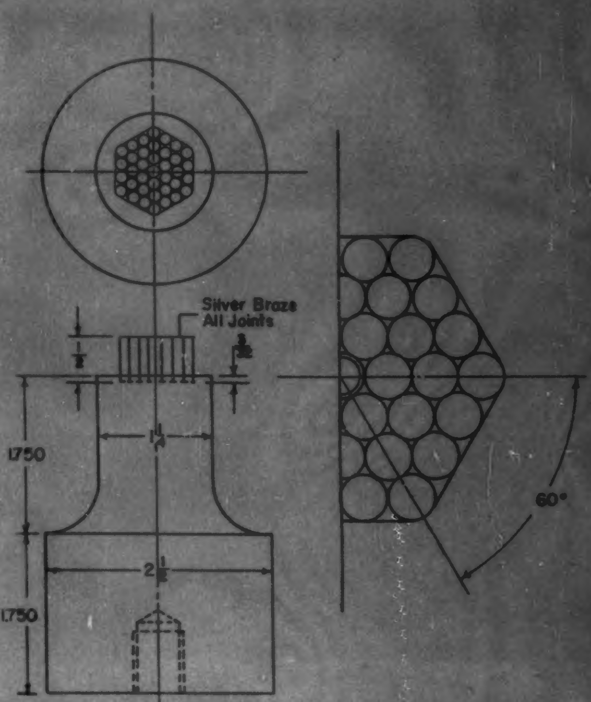


Fig. 3. Typical ultrasonic cutting tool used for dicing silicon wafers. Tip, seen enlarged at the right, is made of hypodermic-needle tubing, and the tool cone, of Monel.

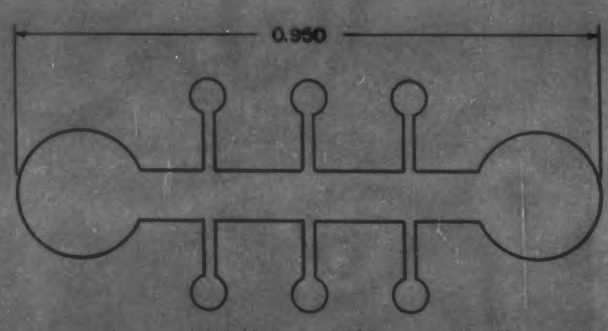


Fig. 4. Versatility of ultrasonic machining is demonstrated in the production of this delicate part. Material of component is single-crystal silicon.

required for each processing consumes approximately five minutes.

Electronic navigational aids for aircraft and many other devices made at the laboratories employ accurate fine-pitch gearing. Tolerances required are those for precision Class 2 fine-pitch gears or closer. For most applications the company has standardized on 96 pitch, precision Class 2 gears. These gears, having total composite errors less than 0.0005 inch and tooth-to-tooth composite errors less than 0.0003 inch, are regularly produced on Fellows fine-pitch gear shapers (Fig. 6). Precision Class 3 gears, less often specified, are obtained by selection and segregation. Composite errors of the gears are checked on a Kodak Conju-Gage. A Pratt & Whitney Super Micrometer is used to measure the pitch diameter over wires, and a Kodak Contour Projector is employed to inspect tooth form.

Generally, the gears are pressed on stainless-steel shafts having bearing surfaces turned to a diametral tolerance of plus 0.0000, minus 0.0002 inch on a jeweler's type lathe. Concentricity of bearing surfaces is held to within 0.0001 inch.

Fig. 5. (Above) Components for traveling wave tubes used in microwave communication equipment are cleaned ultrasonically. Ceramic rods shown are supports for tube elements.

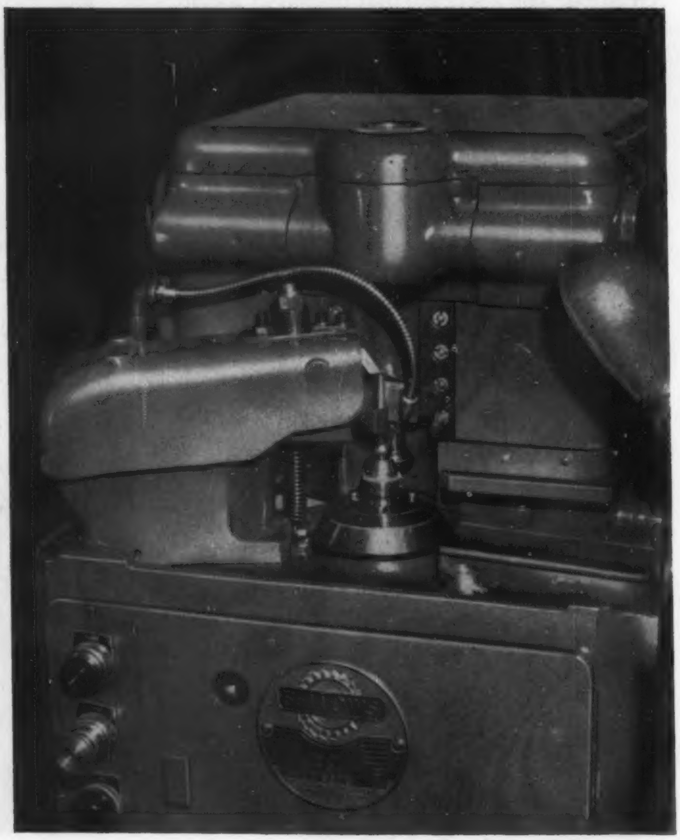


Fig. 6. (Right) Close-tolerance gears employed in electronically controlled aerial navigation equipment are cut on this fine-pitch gear shaper. Precision Classes 2 and 3 fine-pitch gears are required.

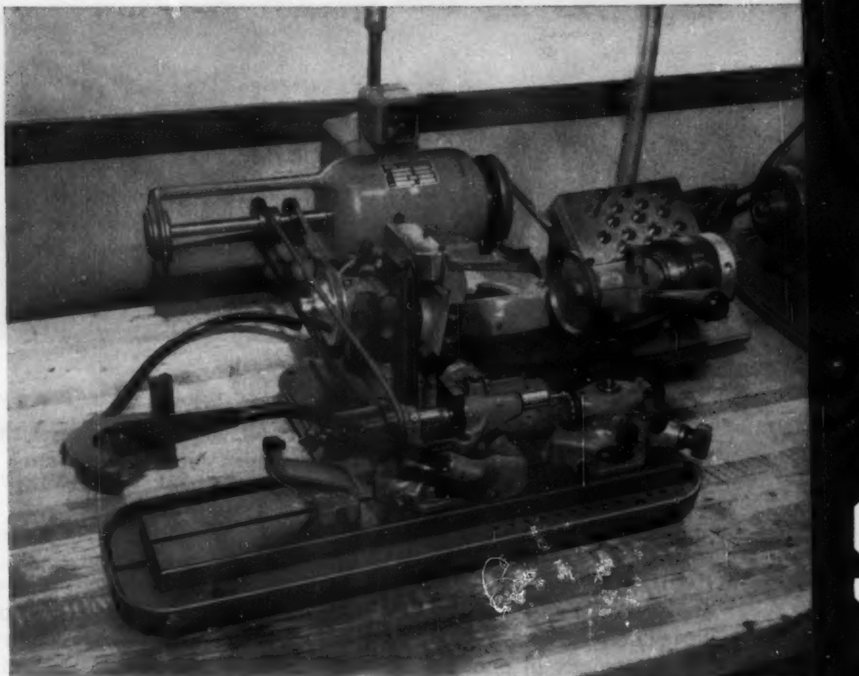


Fig. 7. Here, accurately turned gear-shafts are burnished to size using a carbide wheel having minute cutting grooves. The method produces a 4 micro-inch finish or less.

After turning, the shafts are placed in a Hauser pivot-burnishing machine (Fig. 7) equipped with a tungsten carbide wheel, and the bearing surfaces are burnished. Oriented at a slight angle to the machine axis, minute grooves extend across the face of the burnishing wheel. The edges of these grooves remove some metal during the operation, which takes about three minutes. In burnishing, the bearing surfaces are finished to an accuracy of plus 0.0000, minus 0.0002 inch and a surface roughness of 4 micro-inches. A light oil, approximately SAE 5, is applied to the burnishing wheel by a pumping system integral with the machine.

Plates supporting the gear bearings are bored in a Lindner jig borer. This machine is equipped with an optical arrangement that permits positioning of the work-table to an accuracy of 0.0001 inch. Solid-carbide boring tools are employed, capable of boring holes as small as 0.040 inch. The minimum-diameter bore required for a pivot bearing is 0.046 inch. In the heading illustration, an instrument part is seen being bored in the optical type jig borer.

Wave guides made of cylindrical nickel-silver tubing are bent in various curves while maintaining a constant internal diameter accurate to within 0.001 inch. This is done in a simple but unique manner. The tubing, having a 0.292-inch outside diameter and a 0.231-inch inside diameter, is packed with some material such as fine sand and bent as closely to the required shape as possible. Then it is clamped between two brass plates, each half having a groove of semicircular cross-section curved to the required bend. While the tubing is clamped between the plates, steel balls 0.218 inch in diameter are pressed through it, using an arbor press. The ball size is then gradually increased until a 0.231-inch-size ball, the required inside diameter of the tubing, is pressed through. Smaller-size balls are used to drive the 0.231-inch ball out of the tubing. Multiple and complex curves can be formed in several sections by this technique.

LOCKHEED USES OIL DIES TO MAKE MULTIPLE-BEAD SHEETS

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RUBBER FORMING, embossing, bulging, and expanding of sheet metals have been successfully performed for a considerable number of years and, especially in plants of the aircraft industry, are conventional practice today. In this process, use is made of a single die or form-block which has convolutions similar to those required on the work. The form-block is mounted on the die bolster. The upper die member consists of a thick rubber pad and is attached to the ram of a hydraulic press. When the ram descends, the rubber forces the metal sheet into all cavities of the form-block. The resiliency of the rubber permits the pad to adjust itself in conformance with the form-block convolutions and at the same time to maintain pressure uniformly over the work. In this way, the rubber actually does the forming.

Lockheed experience with rubber forming led to the adoption of a method in which oil is employed instead of rubber to draw-form metal sheets. The necessity of a new method arose in connection with the making of beaded or sandwich types of metal sheets now specified for use in the construction of certain high-strength aircraft and space vehicles.

Examples of such parts are seen on the surface plate in Fig. 1 and in the background. They are of a multiple-beaded design, as can be clearly seen, and are formed from 0.012-inch-thick 2024 aluminum alloy.

Originally, it was planned to produce these multiple-beaded sheets in a hydraulic press equipped with the conventional rubber pad and a single-action form-block. However, when the job was set up, the thin material would not draw cleanly into the bead cavities without wrinkles forming or the metal tearing. In this process the rubber acts both as a punch and a "pressure pad."

Fig. 1. Ultra-thin aluminum sheet in which as many as twenty beads are drawn simultaneously by applying oil pressure directly to the surface of the work.

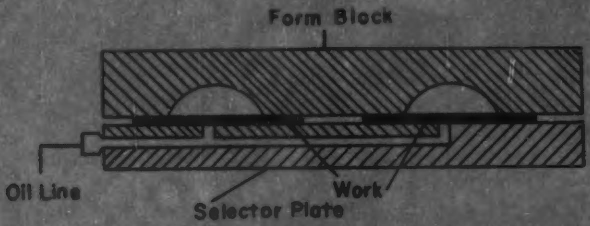


Fig. 2. Diagrammatic representation of form-block and selector plate setup that is employed in forming parts by oil pressure.

It is important that the material around each bead cavity be held smooth while it is drawn into the depression.

Under pressure, the rubber moved over the part in an uncontrolled motion, causing tears in the ultra-thin sheets. Also, wrinkles formed around the flange which is later used as an attaching area when the sheet is spot-welded to an outer skin to form the sandwich or beaded panel assembly.

Aluminum alloy must be formed in the heat-treated or "as quenched" condition to eliminate the distortion that would occur if the part were formed in the annealed condition and later heat-treated. This means that the part must be formed precisely in the press operation, as wrinkles cannot be removed later with hand tools without producing severe marks.

In previous experience with hydraulic forming, it had been learned that individual cups or shells can be draw-formed without the aid of O-rings or seals around the die. While the parts in Fig. 1 contain as many as twenty beads in each stamping, it was decided that each bead could be considered a separately drawn shell. The width to depth ratio is too great to consider the bead as being a "stretch" type of form. Consequently, the original form-blocks or dies made of plastic and aluminum contain flat draw surfaces, as indicated at *A* in Fig. 1. This allows some of the material to be drawn sideways in the forming operation without thinning or tearing of the metal. It was decided that the material should be drawn entirely between hard surfaces to prevent wrinkles by actually performing a drawing rather than a forming operation.

These experiments led to the conception of a process in which oil forced directly on the work surface would serve as a forming or drawing medium. Fig. 2 presents a schematic drawing of an oil-die arrangement consequently developed. It will be observed that one striking difference between this process and the conventional rubber-forming process is that the form-block is attached to the ram instead of being mounted on the die bolster.

A "selector" plate with oil channels on one face extending to holes drilled through the plate, as shown in Fig. 3, is placed on the press bed with a drain pan surrounding it. The drain pan can be

Fig. 3. Appearance of a selector plate on the side that is toward the aluminum sheet on which beads are to be formed. Oil channels can be seen on plate.

readily seen in Fig. 4. The form-block and selector plate are so aligned that the oil holes in the latter are directed toward the cavities of the form-block. Fig. 5 shows the form-block attached to the upper platen of the hydraulic press. The selector plate acts as a pressure pad to hold the sheet securely during the forming process.

With the machine set up, the heat-treated work-blank is placed on the selector plate. Then, the form-block is forced down against the part by the press ram and produces even pressure against the selector plate. Oil is next forced through the selector plate to each bead area. The oil pressure is adjusted so that the sheet material will be forced upward toward the bottom of the various cavities in the form-block. Vents in the form-block allow the escape of air under each bead. A line pressure of 1000 psi is generally used. Incidentally, the selector plate is customarily made of aluminum.

The ram pressure must be adjusted so that it is sufficient to maintain a clamping force on the selector plate that will prevent the form-block from moving upward and allowing the die forming oil to escape between the part and selector plate. It must resist the counteracting force of the oil pressure in the die cavities and at the same time maintain a reasonable pressure on the draw-pad area to properly restrain the flow of metal inward. If the metal flows into cavities without sufficient drawing pressure, it will not "size" correctly or maintain good contours when the work-piece is removed. The clamping force is usually 300 tons.

Parts formed by this process have a range from 20 to 30 inches in width and from 60 to 80 inches in length. There have been as many as twenty beads on one part. The actual forming time to draw all twenty beads is three seconds. The complete forming cycle for such a panel, including loading and unloading, takes less than four minutes. The oil film left on the form-block after each operation provides adequate lubrication for the operation on the next part.

Fig. 4. View of the 650-ton hydraulic press on which sheets are formed by direct oil pressure, showing the drain pan for collecting oil.

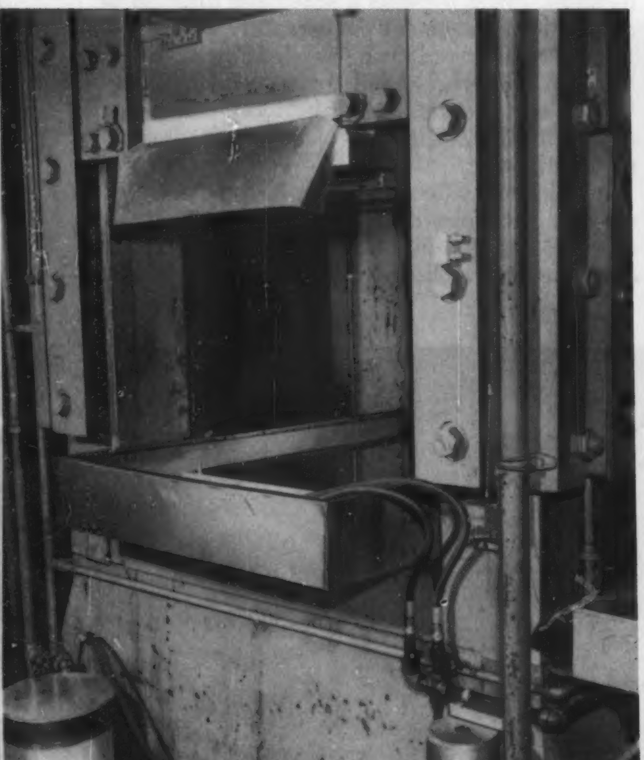


Fig. 5. The form-block in this method of producing multiple-bead sheets is attached to the upper platen of the hydraulic press.

More than fifty-five different parts for Buick's twin- and triple-turbine type automatic transmissions are Superfinished on a total of forty-five machines. Internal, external, flat, round, solid, and interrupted surfaces are all being finished in this way to improve surface finish and geometry of various parts and minimize surface wear

CHARLES H. WICK
Managing Editor

SUPERFINISHING IMPROVES QUALITY OF AUTOMATIC TRANSMISSION PARTS

SUPERFINISHING is a precision metalworking operation in which revolving or reciprocating abrasive stones are held against rotating workpieces under mild pressure. The process differs from grinding in that the stones make area contact with the work. It is employed to minimize surface wear by refining surfaces that have been previously ground, improve surface geometry by removing pitch defects, and increase the effective bearing area of various surfaces.

At the Buick Division of General Motors Corporation, Flint, Mich., Superfinishing is being used extensively for various automotive parts. In fact, for the twin- and triple-turbine, automatic transmissions alone, more than fifty-five different parts are finished in this way on a total of forty-five machines. The machines are made by the Gisholt Machine Co., Madison, Wis. Various model machines are employed to finish both internal and external surfaces that are either flat or round and solid or interrupted.

The setup for Superfinishing two external, cylindrical bearing surfaces on output shafts for triple-turbine transmissions is seen in the heading illustration and Fig. 1. These shafts are forged from SAE 4063 steel, heat-treated to a hardness of 60 Rockwell C, and ground prior to this operation. From 0.0003 to 0.0004 inch of stock (per side) is left on the bearing surfaces after grinding, for removal in Superfinishing.

As can be seen, the machine is equipped with three independently adjustable quills, but only two are used for this operation. The stone-holders on the two quills are equipped with stones 1 3/8 inches long by 3/4 inch wide, having a concave radius of 0.750 inch to fit the bearing surfaces. Vitrified-bond, aluminum-oxide abrasive stones of 320 grain size and J hardness are employed.

Shafts are mounted between a headstock center and a lever-operated tailstock center, and driven by a spring-loaded driver secured to a headstock faceplate. A variable-speed drive is provided to the spindle, but for this operation the work is rotated at 60 sfpm (surface feet per minute). The quills and stone-holders are raised and lowered by hydraulic cylinders. During Superfinishing, the stones are kept in contact with the bearing surfaces under a pressure of 25 psi. A

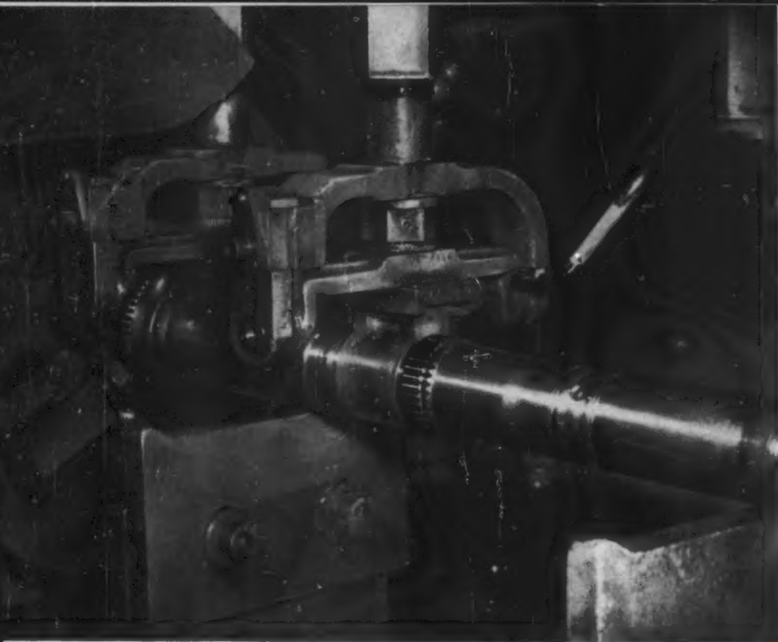


Fig. 1. Close-up view of the Superfinishing operation performed on the machine seen in the heading illustration. Two bearing surfaces on the output shaft are finished at the same time.

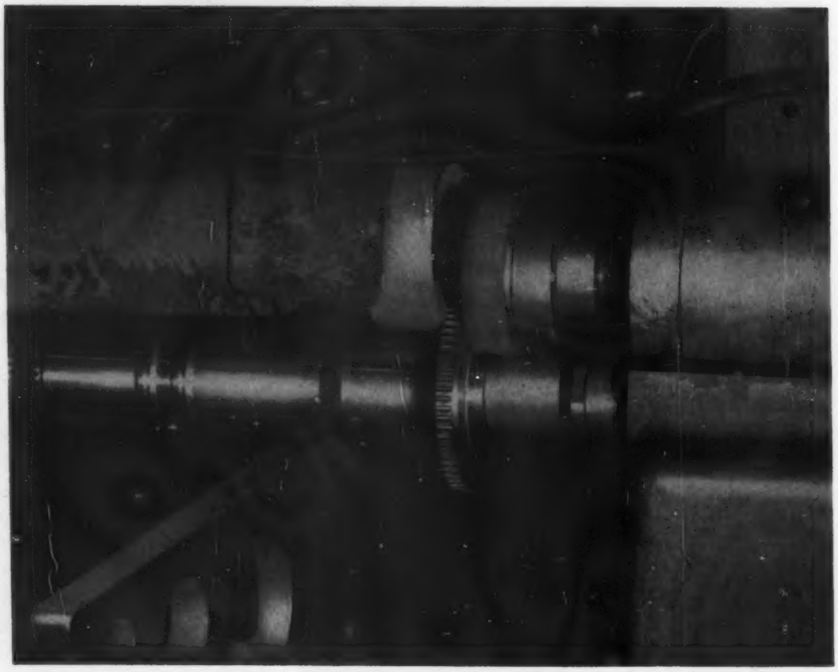


Fig. 2. Two opposed, cup-shaped stones are used to Superfinish both the thrust and seal faces of transmission output shaft flange simultaneously. Automatic cycle requires only twenty-four seconds.

stream of cutting fluid is directed onto the surfaces, just back of where the stones make contact to help the cutting action and wash away abraded particles. The solution used for this and all other Superfinishing operations at Buick contains 85 to 90 per cent mineral seal oil and 10 to 15 per cent International Compound No. 155. A longitudinal traverse stroke of the head (which is adjustable from 0 to 18 inches with automatic dwell and reversing at each end of the stroke) is not necessary in this particular setup. About thirty seconds are all that is required to complete the operation. In this period the specified surface finish of 15 micro-inches is easily maintained.

During the initial part of the automatic cycle, the stones only contact the higher peaks on the surfaces. As the stones break down, sharp abrasive grains are exposed to rapidly remove metal from these peaks due to higher unit pressures. The areas of contact between the stones and the work surfaces become progressively greater as the surfaces get smoother. This reduces the unit pressures on the grains, and decreases the stone breakdown and stock-removal rates. With the

Fig. 3. Superfinishing of piston-bore surfaces in front planet carriers for automatic transmissions is performed on this two-spindle cylindrical machine. Operation requires a twenty-second cycle.

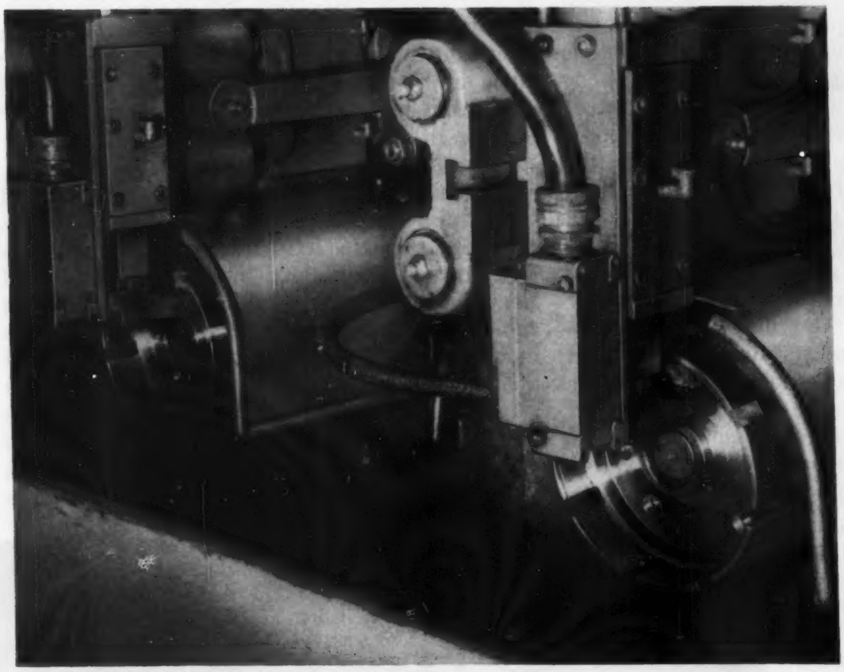


Fig. 4. Close-up view of one of the two spindles on the machine shown in Fig. 3 shows how the stone is mounted on an offset holder so that it can be reciprocated at rates up to 800 strokes per minute.

proper conditions, stock removal is automatically halted near the end of the cycle.

A similar horizontal machine is employed to Superfinish the inner and outer flange thrust and seal faces on the same output shafts. As seen in Fig. 2, both opposing faces are finished simultaneously by two cup-shaped stones, 2 1/4 inches in diameter. Steel-backed, vitrified-bond, silicon-carbide abrasive stones of 400 grain size and M hardness are used for this operation, which requires only twenty-four seconds and produces surface finish of 8 micro-inches.

Piston-bore surfaces in the front planet carriers for the twin-turbine automatic transmission are Superfinished on a two-spindle cylindrical machine, Fig. 3, after they have been precision bored. The same operation is performed on both horizontal spindles—one being unloaded and reloaded while a part is being finished on the other. Work-pieces are held on expanding type, draw-back mandrels, and rotated by means of driving lugs.

Vitrified-bond, aluminum-oxide abrasive stones of 500 grain size and J hardness are used to

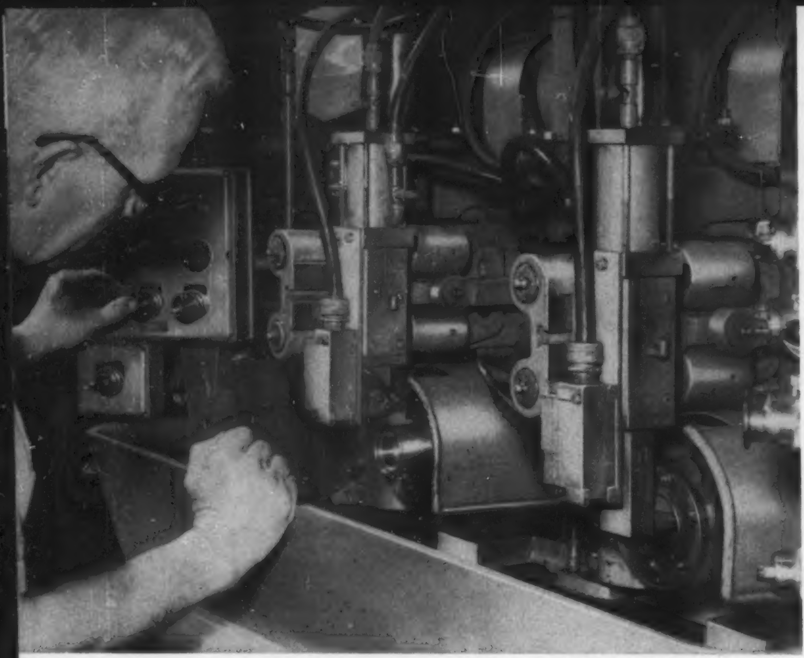


Fig. 5. Two different automatic transmission parts are Superfinished simultaneously on this machine. The peripheries of sleeves are finished at left-hand station, and piston bores at the right.

Superfinish these steel parts, which have a hardness of about 34 Rockwell C. These stones, which measure 3/4 inch long by 3/4 inch wide by 5/16 inch thick, and are formed to a convex radius of 4.750 inches, are mounted on offset holders, as seen in Fig. 4. Reciprocation of the stones is performed at the rate of 800 strokes per minute, with a stroke of 3/16 inch, while the work is rotated at 100 sfpm. About 0.00025 inch of stock is removed per side, producing a surface finish of 25 micro-inches in a cycle of twenty seconds. Subsequently, the hub face and periphery, as well as the end surface of the cup, are Superfinished to 51 micro-inches on two other machines.

Reciprocation produces a crosshatch pattern which can be controlled—by varying the reciprocating speed, work speed, pressure of the stone, lubricant, or specifications of the stone—to produce any surface finish required. The pattern produced encourages lubricant to cling to the surfaces, thus reducing wear of seals, packing-glands, or mating surfaces.

A similar machine, Fig. 5, is employed to Superfinish two different transmission parts simultaneously. On the left-hand spindle, the previously turned peripheries of soft, SAE 1020 steel sleeves on rear stator blade, carrier and bushing sub-assemblies are finished. From 0.0005 to 0.001 inch of stock is removed (from the diameter) and a 15-micro-inch finish is produced. The turned surface, prior to Superfinishing, has a surface finish of 50 to 80 micro-inches. A vitrified-bond, silicon-carbide stone having a 320 grain size and

Fig. 6. Hubs on the primary-pump housings for triple-turbine automatic transmissions are Superfinished on this dual-head machine. Each stone finishes a different surface on the hub.

J hardness is used. The stones are 3/4 inch square by 1 1/16 inches long, and are preformed to a concave radius of 2.082 inches.

On the right-hand spindle, the cast-iron piston bores in stator blade carrier assemblies are finished. Vitrified-bond, silicon-carbide stones of 500 grain size and P hardness are used for this operation. The bores are 3.885 inches in diameter by 9/16 inch long, and a 15-micro-inch finish is produced. On both horizontal spindles, the work-pieces are held by air-operated draw-bar type expanding mandrels.

In this application, both a roughing and a finishing work speed are used. When the starting button is depressed, one of the heads descends and traverses to the required longitudinal position. Then the stone-holder is either raised or lowered to bring the stone into contact with the work under air pressure of 25 psi. During roughing, the work is rotated at a surface speed of 50 sfpm. After a pre-set time, the work speed is automatically changed to 90 sfpm for finishing. A Reliance electronic variable-speed drive is provided on the machine for this purpose. The automatic cycle is arranged to permit alternate loading and unloading of the two work stations.

Barnesdril Kleenall combination magnetic and fabric filters are provided on all the Gisholt Superfinishing machines at Buick for continuous cleaning of the cutting fluid. Used fluid first flows through a magnetic field of a permanent-magnet drum for removal of the ferrous particles and entrained material. Then it passes into the filtering area for positive removal of the remaining contaminants by the roll fabric.

A machine having dual reciprocating heads and a single work-holding spindle, Fig. 6, is employed to Superfinish the two-diameter hub peripheries on primary-pump housings for the triple-turbine automatic transmissions. The housings are made from modified SAE 1062 steel, hardened to a minimum of 60 Rockwell C. Prior to Superfinishing, the hub surfaces are ground to diameters of 2.3726 inches (by 1 1/8 inches long) and 2.4998 inches (by 5/8 inch long). Vitrified-bond, aluminum-oxide abrasive stones of 400 grain size and J hardness are used to produce a surface finish of 15 micro-inches.

Surface geometry of the work-pieces is improved in Superfinishing by removing both short- and long-pitch defects. Short-pitch defects include grinding ridges, while typical long-pitch defects are chatter marks, feed spirals, grinder flats, and other waviness caused by inaccuracies in the machine or the heat generated in stock removal.

Two single-spindle, vertical Superfinishers have been mounted together, as seen in Fig. 7, to finish both ends of steel disc-and-hub assemblies for the first turbine converters. On the machine shown in the foreground, the end face of the rear hub is finished, and on the other, the face of the counterbored front hub. These surfaces are previously ground to a surface finish of 40 micro-inches. In Superfinishing, from 0.0003 to 0.0004 inch of stock is removed per side, and the surface finish is improved to 20 micro-inches.

Fig. 7. Two single-spindle, vertical machines are mounted together for Superfinishing both ends of disc-and-hub assemblies for the first turbine converters of transmissions.

The work-holding fixture for finishing the end face of the rear hub is shown in Fig. 8. The hub of the assembly *X* is located in an adapter *A*, which is secured to a plate *B* that is mounted on the work-spindle. Two arms *C* attached to the adapter have vertical pins *D* on their outer ends to drive the assembly. The Superfinishing stone is seen at *E*.

The interrupted surfaces of the pump faces on flange-and-bushing assemblies for converter reaction shafts are Superfinished in the setup seen in Fig. 9. Only one of the two single-spindle, vertical machines (both of which perform the same operation) is shown. The reaction flange of this sub-assembly is shell-molded cast iron, 9 3/16 inches in diameter and having a bore 2 3/8 inches in diameter.

Prior to Superfinishing, the flanges are faced—

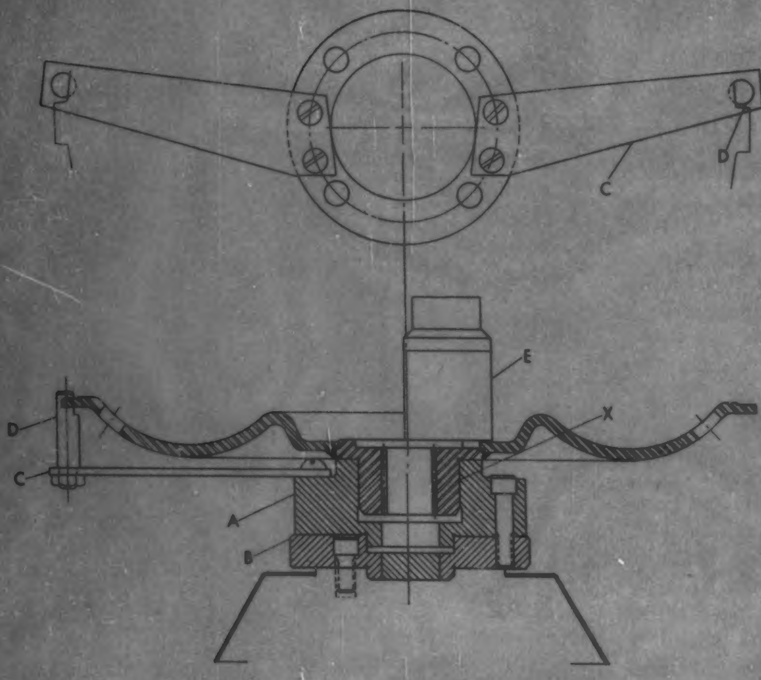


Fig. 8. Disc-and-hub assembly (X) is located in adapter (A) and driven by pins (D) mounted on the ends of arms (C). Stone for Superfinishing end face of the rear hub is seen at (E).

leaving up to 0.001 inch of stock to be removed in a thirty-two-second finishing cycle. A face-grinding operation previously performed between the facing and finishing operations has been eliminated. While Superfinishing now takes longer, the time saved by eliminating the grinding operation more than offsets the difference.

Cup-shaped stones 3 1/2 inches in diameter by 11/32 inch thick and having a bore 1 1/4 inches in diameter are used for this operation. No reciprocation is employed. The stones are lowered into contact with the work surface, and kept in contact by spring pressure. A timer automatically controls the length of cycle, and a surface finish of 8 micro-inches is produced. Flatness is maintained within 0.0002 inch.

Fig. 9. Setut for Superfinishing interrupted pump face on flange-and-bushing assembly for converter reaction shaft. Up to 0.001 inch of stock is removed in a thirty-two-second cycle.

Bliss Builds 140-Foot Radio Telescope to Probe the Heavens

Precision metalworking on a grand scale is the order of the day when dealing with components such as a 2 1/2-million-pound yoke, a 22-foot spherical bearing, and a reflecting surface about a half acre in area

SOME of the most unusual manufacturing setups ever devised in its 100-year history have been worked out by the E. W. Bliss Co., for a 140-foot radio telescope it is now building for Associated Universities, Inc. This is a non-profit organization that establishes and operates large-scale research facilities on behalf of the entire academic community, and is sponsored by nine northeastern universities.

One of the largest scientific instruments ever designed, the telescope combines great size and weight with the watch-like precision necessary to track extremely feeble sources of radio emission in outer space—perhaps ten billions of light-years away. In some cases these signals come from stars so remote that their once-powerful radio emissions reach the earth as signals of such diminished strength they might well be compared to the output of a one-watt bulb spread over the entire surface of the earth. The radio telescope is to be installed as part of the National Radio Astronomy Observatory in Green Bank, W. Va.

As prime contractor, Bliss is responsible not only for fabricating the parts of the giant research instrument, but also for erecting it and placing it in operation. The magnitude of the project and the need for exacting precision at all stages have created innumerable metalworking problems. Engineering ingenuity has met each of these problems as it arose. For example, in the company's Canton, Ohio, plant can be seen a machine tool aligned with a precision theodolite . . . a 42 1/2-foot aluminum television mast, of the kind used in remote rural areas, holding a tiny scriber for marking gear segments . . . welding units mounted so that they can be swung to any point

Fig. 1. Some idea of the size of the telescope parts can be gained from this cantilever arm. Two of these arms, each weighing 180,000 pounds, form a part of the yoke.

above a huge assembly pit and . . . almost half an acre of aluminum plate waiting to be formed into the 15,000-square-foot parabolic "dish."

Spatial radio waves are gathered by the reflector, or dish. Since it is 140 feet in diameter, it has a total area of approximately three-eighths of an acre, yet must not vary from a perfect parabolic shape by more than 1/16 inch for antenna efficiency. It is constructed of 1/4-inch-thick aluminum plates, each measuring 25 feet in length and 12 feet in width. To form these plates to the required accuracy, Bliss will turn to epoxy-resin dies, and has already developed some special forming techniques for the job.

Four 80-foot aluminum tubes rise from the dish and meet at a point 60 feet above the center. About one-half ton of electronic receiving equipment, into which the dish feeds its celestial signals, is suspended at this focal point. It must not deflect more than 1/32 inch, regardless of the telescope's position. The framework and supporting structure of the reflector will have to be assembled on the ground and then raised—as a 350-ton unit—more than 150 feet into the air to be mounted on a yoke.

The yoke, which supports the dish, is the biggest single unit in the telescope—totaling close to 2 1/2 million pounds of steel, concrete, and balancing blocks. Because of its size and weight, it is being built in sections and will be shipped to West Virginia, where it will be assembled and welded at the site. An idea of the size of the telescope components can be had from Fig. 1. This is one of two cantilever arms, each weighing 180,000 pounds, that form a portion of the yoke.

Another large component that is nearing completion is the polar-axis shaft. Sixty-seven feet long, 12 feet in diameter, and weighing approximately 1,600,000 pounds, it requires a special welding arrangement dubbed "Anxious Alice," Fig. 2.

The shaft section is supported in a pit, while above it, twin welding heads are moved along a rail suspended at both ends from radial drilling machines. Thus, the heads can travel in any di-

Fig. 2. Fabricating the polar-axis shaft. Two welding heads move along a rail, forming a common puddle to weld the 15-foot long by 7-inch deep seams. Seventy-nine passes are needed for each seam.

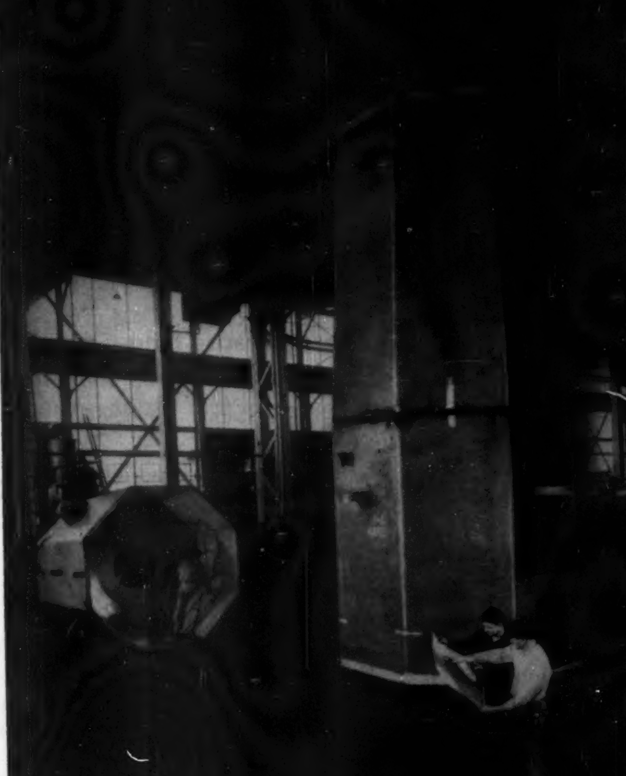


Fig. 3. Two sections of the polar-axis shaft have been assembled for match-marking. When installed on the telescope, the shaft and its ballast elements will weigh approximately 1,600,000 pounds.

rection over the pit. There are eight seams to be joined, each 15 feet long and 7 inches deep. To fill each seam with weld metal requires seventy-nine passes. The assembling of two sections of polar-axis shaft for match-marking is shown in Fig. 3.

An unusual technique is used to cut the teeth (which have 3 1/2 inches between centers) in the segments of the polar-axis gear. When assembled, this gear will have a diameter of 85 feet. Conventional gear-cutting methods cannot be used because the segments average 30 feet in length. Moreover, each segment has to be accurately scribed with a pitch line located at a 42 1/2-foot radius from a central point, and held within a tolerance of plus or minus 0.002 inch.

To do the job an ingenious arrangement (Fig. 4) was evolved, utilizing a radial drill stand (not shown) and a 42 1/2-foot television mast—because of its cantilever construction, one of the most rigid standard structures obtainable in that length. The radial drill stand was used because it provided adjustments for obtaining precise elevation settings while serving as a rigid pivot around which the mast could swing. A precision theodolite, set up at the drill stand, was used to set the scriber at exactly the right position on the end of the mast.

When the gear segments have been completed, they are bolted to backing sections cut from a girder. Keyways in the ends of each gear segment are keyed together, using shims to achieve the necessary circularity and flatness. The sections are then bolted together by means of splicing plates. When assembled, the gear and gear girder must not deviate more than 1/16 inch from true perpendicularity with the polar-axis shaft.

One of the most interesting metalworking jobs will be done not in Canton, but at the National Radio Astronomy Observatory site in Green Bank. Here, a 22-foot-diameter spherical bearing will be turned to within 0.005 inch of perfect sphericity. To do this, Bliss field engineers will set up a lathe headstock and all the necessary checking and gaging equipment at the site.

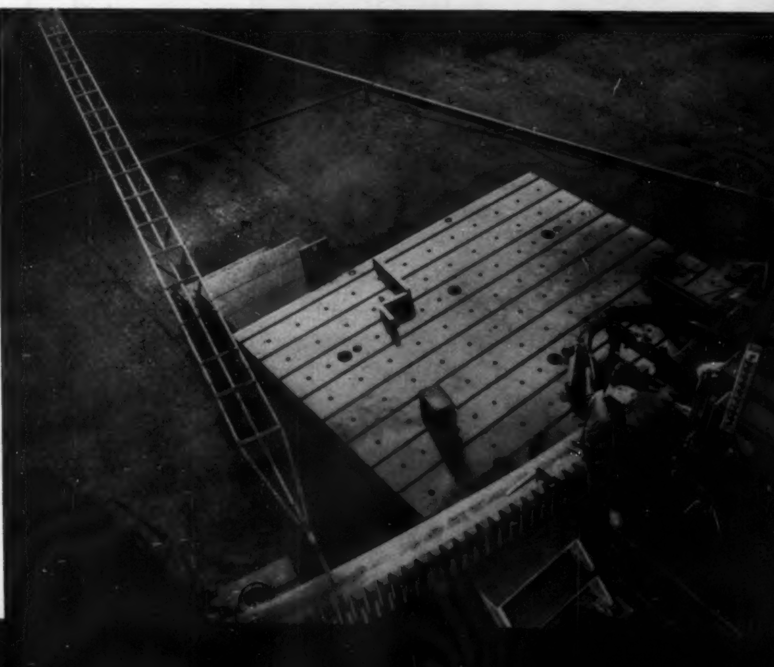


Fig. 4. A 42 1/2-foot aluminum television mast is part of setup used to mark the pitch line on polar-axis gear segments. A scriber mounted on the end of the mast was accurately set with a precision theodolite.

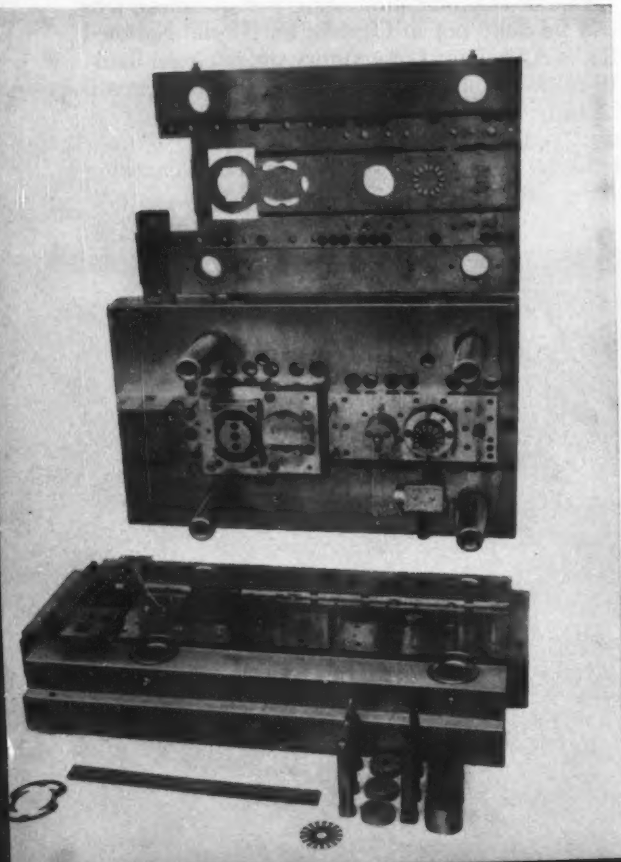
Interchangeability Increases Versatility of
CARBIDE DIES

Highly precise tungsten-carbide dies of sectionalized design have interchangeable components which permit blanking parts of different size and shape. Increased production and lower costs result

CLYDE E. SMITH, Plant Manager
Oberg Mfg. Co., Inc., Tarentum, Pa.

CARBIDE DIES should be considered when high production, abrasive materials, critical tolerances, and/or part quality are involved. However, each application considered should be carefully analyzed to be sure that carbide is physically and mechanically adaptable to this particular piece part.

While the cost of carbide dies may range from 1.5 to 2 times that of comparable, good quality, tool-steel dies, their life may be from 10 to 25 times—with a minimum average of about 10 times—the life of comparable, conventional steel dies. Further economies are possible if the dies are of sectionalized design with interchangeable components. To insure guaranteed interchangeability, a high degree of accuracy must be maintained in manufacturing the dies.



When any part of a die having interchangeable components becomes broken, the customer can report the detail number, receive a replacement which will fit accurately into place, and return the die to service immediately. Interruptions in production are kept to a minimum. Since only the specific part that is broken need be replaced, substantial economies result.

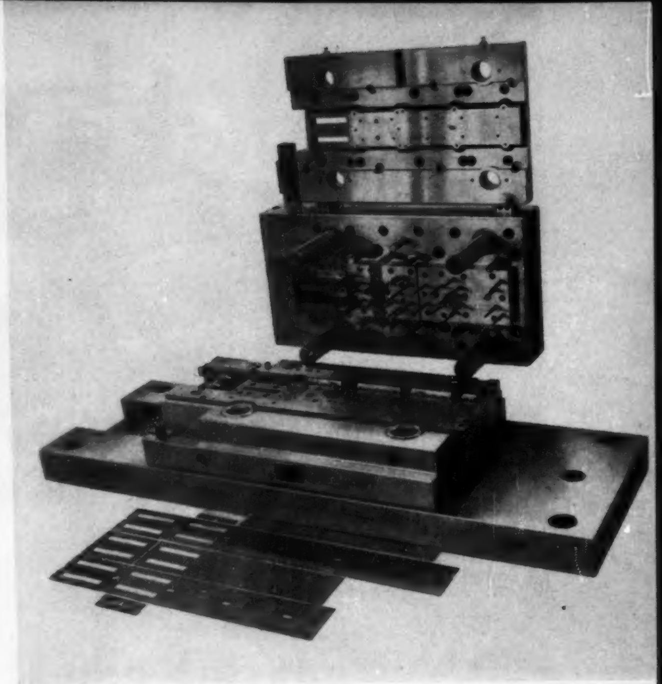
Interchangeability of die sections and punches also permits making different parts with the same tool—in many cases without its having to be removed from the press. This results in lower costs (since fewer dies are required for a given output) and increased production possibilities. Several dies designed and built by Oberg Mfg. Co. with this interchangeability are described here.

Rotors having four different-size center holes can be produced on the progressive carbide die shown in Fig. 1. Three of the four sets of interchangeable center-hole punches, pilots, guide bushings, and die bushings can be seen in front of the die, at the right—the other set being mounted in the die.

This die, which produces a rotor and a stator with each stroke of the press, is of semi-scrapless design. No scrap is allowed between the blanks, and little or no scrap on the outer edges of the material. This design permits up to approximately 10 to 12 per cent material savings, flatter stator parts, and improved concentricity. At the top of the illustration is the spring type, hardened tool steel stripper, which is fully guided on removable posts. The die-shoe and punch-holder are made of normalized Meehanite, and the carbide die sections are 1 1/4 inches thick.

Fig. 1. Progressive carbide rotor-stator die having four sets of interchangeable punches, pilots, and bushings for producing rotors having different-size center holes.

Fig. 2. Five different types of E- and I-shaped transformer laminations can be produced on this one die by simply adding, removing, or changing the necessary punches, pilots, and bushings.



The progressive carbide die seen in Fig. 2 is designed to produce five different types of E- and I-shaped transformer laminations—three of which are shown in front of the die. By simply adding, removing, or changing the necessary punches, pilots, and bushings, this die will blank RMA (Radio Manufacturers' Association) transformer laminations having two holes and a slot, or two holes only. Also, it can be set up to produce standard laminations with three holes, two holes, or two holes and a slot.

This die, which measures 12 1/2 inches wide by 19 inches long, operates on a 60-ton press with a 1-inch stroke. Blanking pressure required, based on 26-gage material, is 27 tons. The die has been averaging 800,000 strokes per grind, and is operated at 275 strokes per minute. Clearance between the slender punches and the interchangeable stripper inserts does not exceed 0.0005 inch on a side. This prevents the punches from touching the mating cutting edges of the die in the event of a misfeed. The only scrap produced with this die is the slugs pierced from the material.

With the progressive carbide die seen in Fig. 3, various punches can either be activated or made inactive. This permits producing five different types of lamination blanks without removing the die from the press. A certain quantity of each type blank is required for one solenoid pack. Previously, three different dies were used for this requirement. All parts are delivered by means of two stacking chutes.

Activation or deactivation of the various punches required for the different blanks is accomplished by sliding wedge blocks mounted in the punch-holder. When these blocks are advanced or retracted by manually operated screws attached to the blocks, the appropriate punches are lowered into blanking position or raised so that they do not pierce the strip. Selection of the particular part to be blanked is made while the die is in the press, and adjustment of the punches does not in any way disturb the die setup.

A refinement of this design principle, which makes the operation—including shifting of the punches—completely automatic, has been incorporated in the dies shown in Fig. 4. Here, the sliding wedge blocks for lowering or raising the required punches are actuated by air cylinders instead of hand screws. Also, the cylinders are automatically cycled by a Cyclo-Monitor electromechanical control unit, made by the Counter & Control Corporation, Milwaukee, Wis.

In this way, the required number of different parts for a complete stack, ready for assembly, are automatically produced in the proper sequences. Also, the control automatically compensates for variations in stock thickness by adding or removing a part to or from each stack as re-

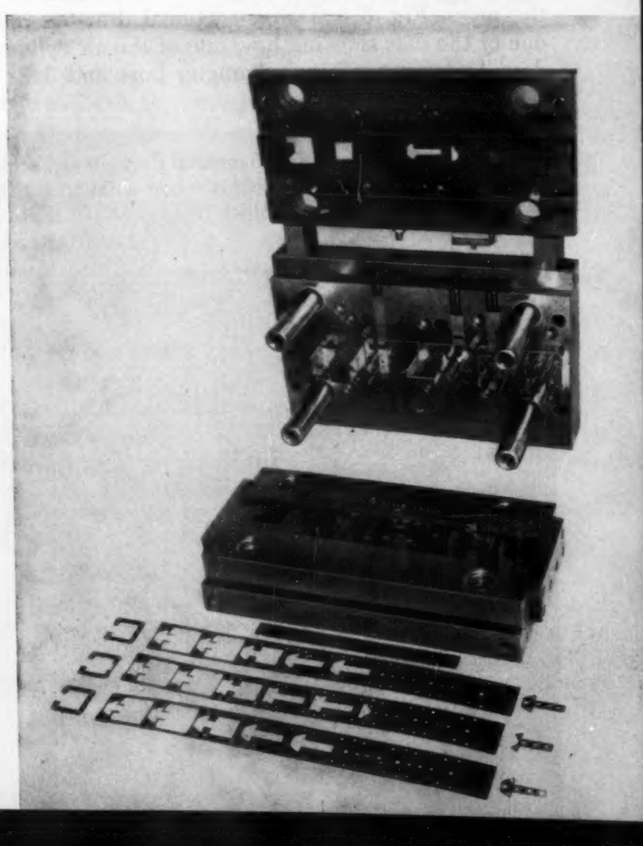


Fig. 3. Various punches on this die can either be made active or inactive by actuating screw-operated, sliding wedge blocks that are mounted in the punch-holder.

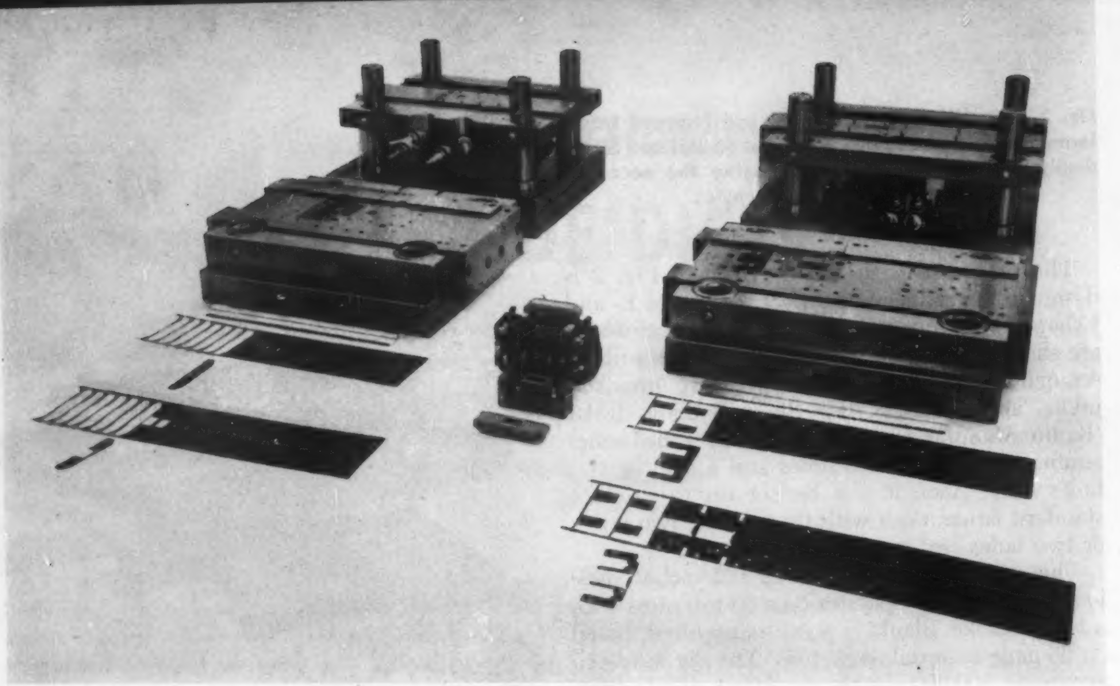


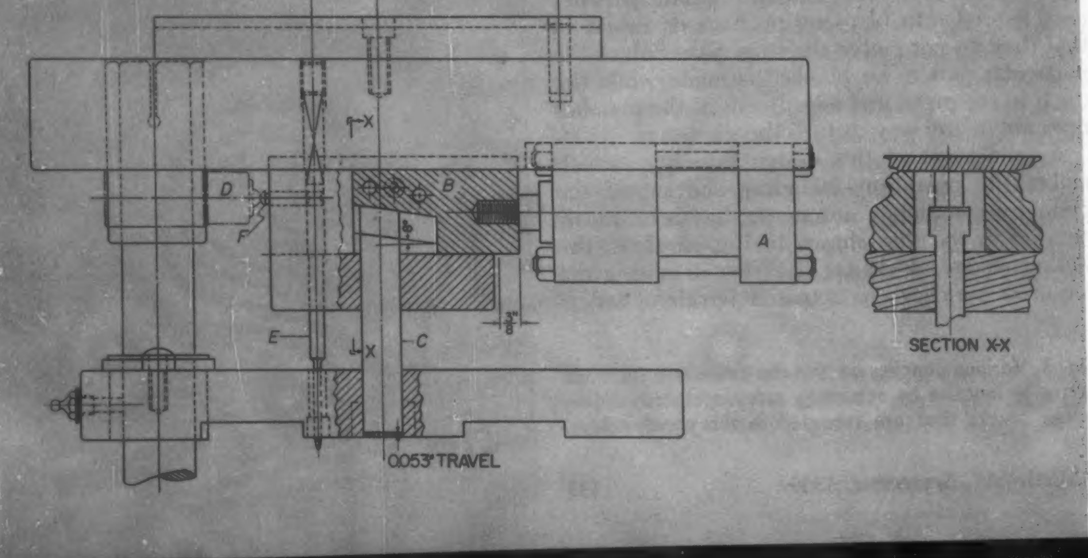
Fig. 4. On these progressive carbide dies, the punches necessary to produce different laminations are lowered into position by means of air-cylinder-actuated wedge blocks.

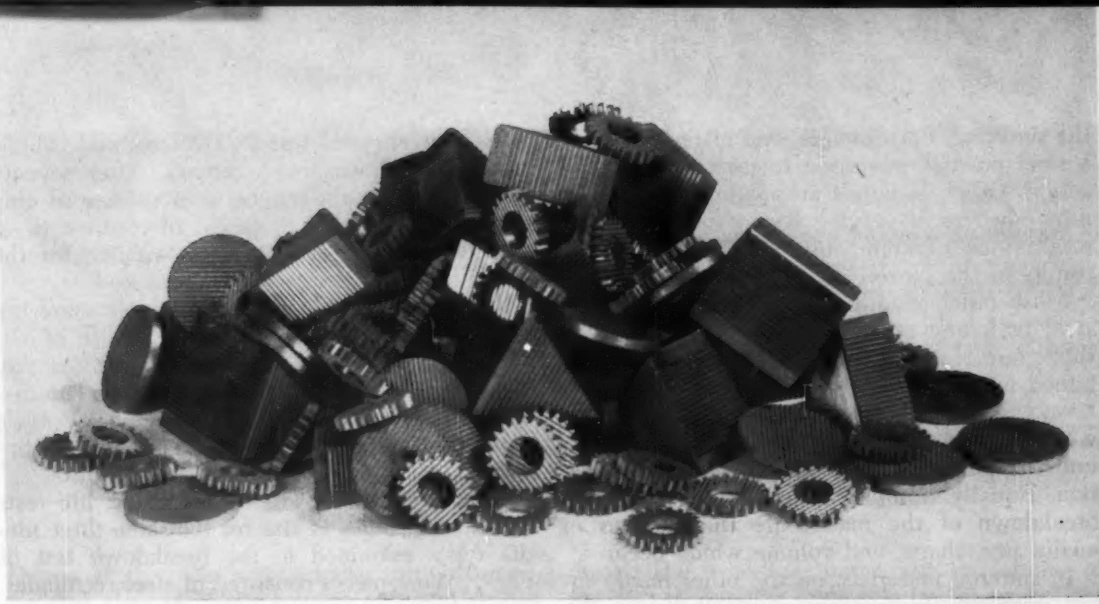
quired, and notching one corner of the last part in each stack to facilitate separation. The operator does not have to stop the press or make any adjustments.

The progressive carbide dies seen in Fig. 4 are used to produce E- and I-shaped armature laminations for motor starters. Each die makes a matching pair of laminations with every stroke of the press. Fig. 5 is a cross-sectional drawing of one of the dies showing how one of the air cylinders *A* (having a 2-inch-diameter bore and 3/8-inch-long stroke) reciprocates wedge block *B* to raise or lower one of the punches *C*, depending on the type of lamination to be produced.

This die is also provided with electrical misfeed detectors which automatically shut off the press when material is improperly or unevenly fed into the die. This is accomplished by means of a small electrical switch *D* that is kept in contact with pilot pin *E* by a plunger *F*. If the pin does not enter the pilot hole in the material, the switch is actuated and the press stopped.

Fig. 5. Sectional drawing of one of the dies seen in Fig. 4 shows how punch (C) is raised or lowered by the action of cylinder (A) on wedge block (B). Switch (D) shuts off press in case of misfeed.





Powder-Metal Media for the Tumbling Barrel

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BARREL FINISHING, or tumbling, is quite frequently the only feasible means of deburring, cleaning, and improving the surface of small parts in volume quantities. But as tolerances on dimensions, radii, and finish grow more critical, it becomes increasingly difficult to obtain consistent results, because of the variables inherent in conventional barrel-finishing media and methods.

Careful attention to tumbling media selection, charging proportions, cycle time, and barrel speed will go a long way toward producing good results. Uncontrollable changes which occur in the media during the actual run, however, limit the degree of consistency obtainable. In a typical tumbling operation, the media continuously changes size and shape, with a consequent shift in relationship of the volume of the media to that of the work-pieces and the liquid vehicle. This, in turn, alters contact pressure and cutting characteristics.

Changes in media size and shape also may create adverse packing, clogging, and loading conditions, all of which affect the uniformity of finish over different areas of the work-piece, as well as between one work-piece and another. None of these changes occurs in an entirely regular or predictable manner. As a result, arriving at a satisfactory over-all procedure for barrel finishing a particular part generally is a matter of trial and error. Where requirements are critical, the attention that must be given to the operation can easily become costly.

In seeking a more standardized and reliable barrel-finishing procedure, Dixon Sintaloy found an answer in media of sintered powder metal—the same substance used in the company's own products. Powder metal, it was found, offers unusual capabilities as a uniform barrel-finishing media which could be produced in a variety of shapes and sizes.

One of the characteristics of sintered materials which makes them particularly good barrel-finishing media is their structure. By nature, the material is porous. When metal powders of varying composition are compacted under high pressure and sintered, the resultant structure can consist of hard particles surrounded and held together by a relatively soft matrix. When abraded, the matrix wears away, continuously exposing the hard particles.

The size and hardness of the particles and the extent of the wearing action that takes place can be predetermined and controlled over wide limits, according to the type of material and the method of its preparation and handling during

the sintering. For example, one material may be a steel powder processed to give good cutting action. Other materials are made from non-ferrous powders of varying hardness and porosity to produce different, but always controllable, results in the barrel.

Most other readily available media, except steel balls and cones, whether natural or synthetic, are of a type in which an abrasive is contained in a matrix. During tumbling, the matrix breaks down and releases the abrasive particles, which are subsequently pounded and impacted into the parts, causing loading and contamination. Equally troublesome consequences of the breakdown of the matrix are the changes in media size, shape, and volume which occur.

In sintered materials, on the other hand, unless purposely impregnated with abrasives, the matrix and particles are of the same general composition and differ only in hardness. Thus, a breakdown into two widely different materials having different cutting effects does not occur. Because of the more intricate bonding, media wear is slow and at an even rate. Cutting action is more constant and predictable throughout the run, and the problem of contamination is reduced to negligible proportions.

A convenient method of measuring and comparing the extent of media breakdown consists of plotting the change in media volume against tumbling cycle time. Fig. 1 gives volume change versus cycle time for three different materials tested: an aluminum-oxide chip; an aluminum-oxide triangle; and Sintabur, one of the Dixon Sintaloy powder-metal shapes. A neoprene-lined hexagonal bench tumbler was charged with equal volumes of the three materials, with water, soap, and rust preventative added to cover the mass. Barrel speed was 28 1/3 rpm, and volume measurement was made hourly. After seventy hours, there was a reduction in volume of only 10 per cent for the Sintabur, in contrast to 40 and 80 per cent reductions in volume for the other two media.

Changes in size and shape are even more important determinants of the useful life of the media than is the change in volume. As size diminishes, cutting action slows down. The material must continually be regraded or cycle times must be extended; in either event, the operation is less efficient and harder to control.

In Fig. 2 are shown the results of life tests based on changes in size for the same three media types examined in the breakdown test of Fig. 1. Work-pieces consisted of steel rectangles. Separate runs were made for the three media, and each run was ended when the media had been reduced to 20 per cent of original size. Media ratio (media volume versus work volume) was 4 to 1. The same equipment and running speed were used as for the breakdown test.

Results indicated a useful life for the powder-metal media four to ten times that of the aluminum-oxide chips and triangles. Aside from the obvious economic advantages, a longer useful life also means that more consistent processing results can be expected over a longer period of time—of particular importance where precision parts are concerned.

Conventional media are classified according to their shape and dimensions. Some are crushed materials which have to be screened and sized. Although possessing individual irregularities, these materials conform to some general shape.

Others are molded or abrasive products which tend to change size and shape rather rapidly.

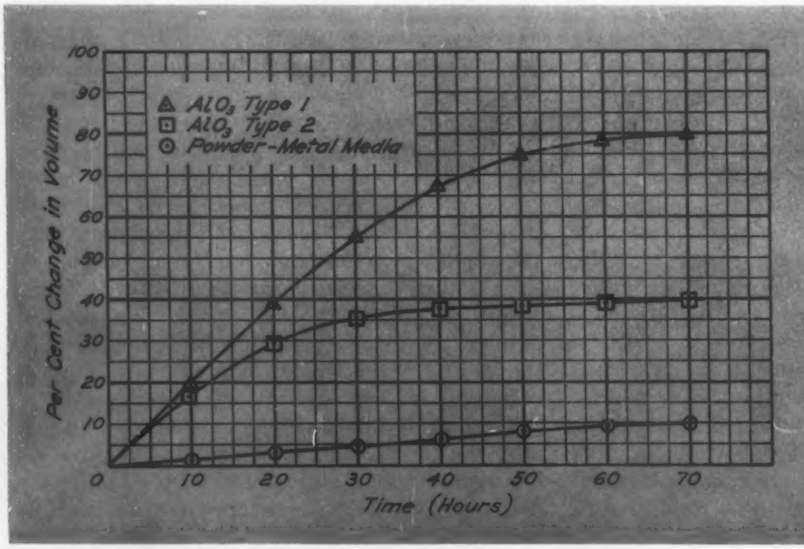
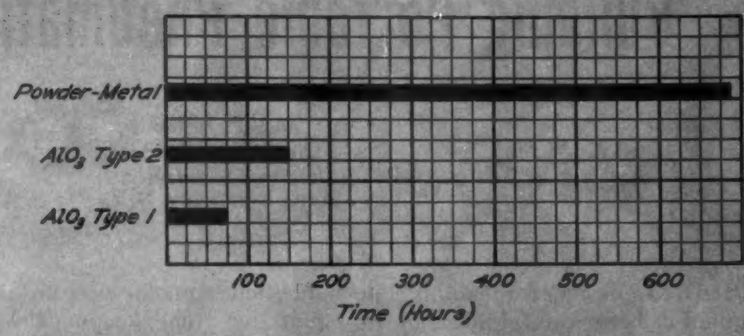


Fig. 1. When three different media were run at the same time, the powder-metal material showed the least amount of breakdown.

Fig. 2. Separate tests of three media showed that the powder-metal material had a much greater useful life.



(Many of them do so to expose the abrasive.) Another class of media consists of metal shapes which are mass-produced. These are characterized by a high degree of uniformity. Changes in shape and size exist only to a limited extent.

On the other hand, producing media by powder metallurgy opens up entirely new possibilities because a wide variety of sizes and shapes can be obtained relatively inexpensively. Media can be designed for a particular finishing requirement. It no longer is necessary to work with media that are either of a single nature or, at the other extreme, are only theoretically standard and consist actually of many different sizes and shapes. This flexibility in size and geometry of the powder-metal media permits effective barrel finishing even where a variety of conditions exist, such as where the work-pieces have holes and radii of different sizes and must be tumbled without entrapment of the media.

Barrel finishing is to a greater extent a filing rather than a grinding action so far as precision work is concerned. The best, but most expensive, finishing procedure would be to hand-process each part by individual filing.

However, the design freedom of powder metallurgy permits incorporating file-like serrations of various kinds on nearly all surfaces of the media, as can be seen in the heading illustration. The serrations improve cutting and finishing characteristics, and also raise efficiency by increasing the pressure contact between the media and the work. They last over the life of the media, yet do not add noticeably to the cost. It is difficult or impossible to design the serrations into other media.

Another feature of powder-metal media is a suitability for impregnation with auxiliary compounds. Where parts are subject to wear in service, excellent results have been obtained with dry-film lubricating agents, including molybdenum disulphide and graphite compounds. The compound is burnished into the work surface during the tumbling, improving the ability of the part to function without oil or grease.

Being porous, the powder metal can also be impregnated with controlled percentages of cutting and polishing agents. Among those under study are aluminum oxide, garnet, silicon carbide, and jewelers' rouge. Either "pure" or impregnated, the new media weigh more than other types, so they do not tend to separate from the work, irrespective of the media ratio. This is of particular advantage in dry tumbling, and permits greater work loads per barrel.

Since the time Dixon Sintaloy began producing the powder-metal media for its own use, limited quantities have been made available to other manufacturers for testing and evaluation. Sufficient experience has now been acquired in a variety of applications. No significant changes in conventional tumbling equipment have been found necessary, although the use of lined barrels has proved helpful for precision work, in maintaining cleanliness and preventing contamination. The media can be introduced into existing finishing lines without major changes in approach or in setup or running time.

In changing over to the new media, experience shows that following normal procedures and checking the work frequently as the run proceeds will indicate optimum cycle time and barrel speed. Once the cycle has been fixed for a particular part, close scrutiny by the operator will not be required.

As might be expected, the advantage in using powder-metal tumbling media is less pronounced where rough work is involved and where other media work well. For many precision and semi-precision applications, however, the new media provide a degree of process control that in the past has been difficult to obtain. While the sintered material is initially more expensive, the added cost is more than offset by its longer life and by the more consistent appearance of the barrel-finished parts.

Building Portable Pneumatic Grinders

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BUILDING designed reliability into a finished product calls for careful attention to minute detail all along the line. Inaccuracy, even in minor phases of manufacture, can jeopardize product performance.

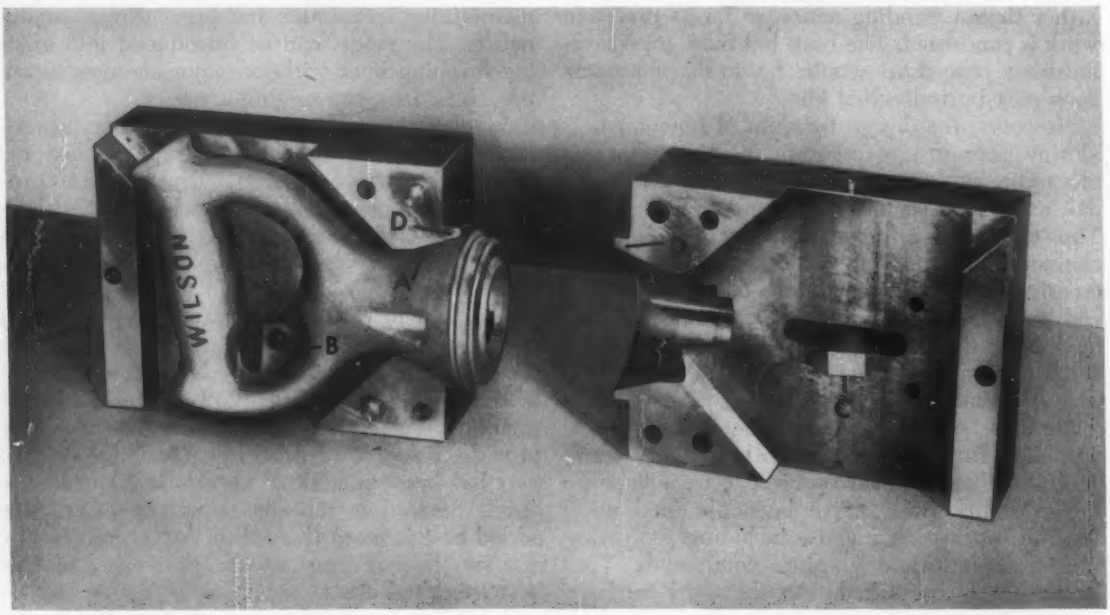
It was with this in mind that Wilson recently developed a line of portable pneumatic grinders of the types used extensively in foundries, steel mills, die shops, and toolrooms. Included in the line are horizontal grinders and high-speed die grinders. Throttle handles for the horizontal grinders are manufactured in interchangeable lever, straight, and grip types.

Of special interest is the grip type handle. Cast from high-impact aluminum alloy (195), it is solution heat-treated to the T4 condition before machining for increased strength. The handle contains intricate coring to provide maximum air flow, as well as an independent oil reservoir. Wall thicknesses are maintained at 3/16 inch to provide pressure-tight cavities while, at the same time, keeping the weight of the finished casting below 2 pounds.

Machining of this casting is complicated by its unusual shape, necessitating the use of the split work-holding fixture shown in Fig. 1. The casting is centralized on a 40-degree conical section *A* which engages the tapered portion of the grip handle. A pie-shaped segment *B* is swung into engagement with the 3/16-inch-wide trigger slot in the casting and is locked in place. This orients the longitudinal axis of the casting parallel with the bottom plane of the fixture. The opposite half of the fixture is then bolted in place and a pivoted clamping finger *C* is pulled back against the inner surface of the handle. The clamping finger holds the aluminum casting rigidly within the fixture, utilizing the principle of a draw-in type collet.

When locked up, the fixture is mounted on an

Fig. 1. Cast-aluminum, grip type handle for portable pneumatic grinder is shown with split lathe fixture. When the fixture is closed, clamping finger (C) pulls the handle back, locking the part against conical section (A).



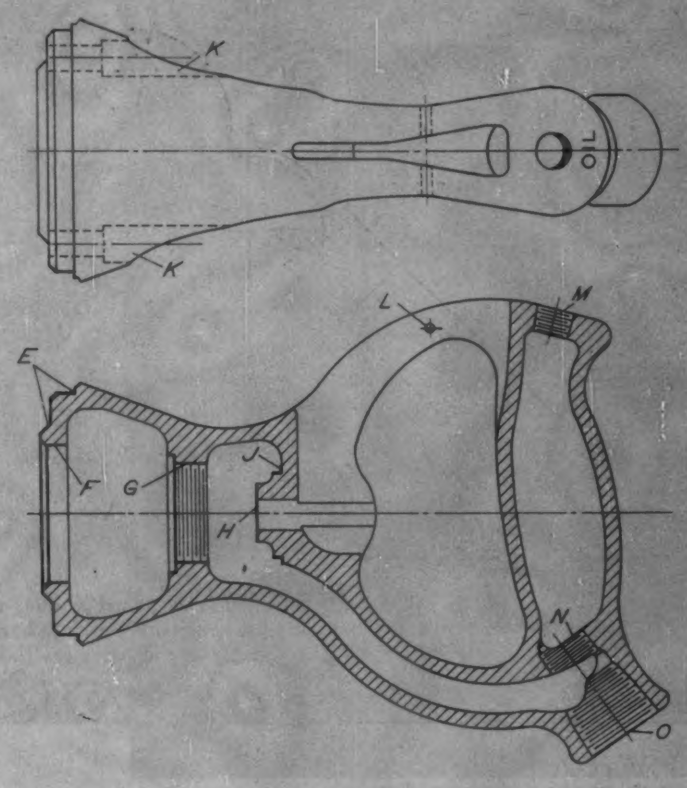


Fig. 2. Surfaces of the grip handle to be machined in the lathe fixture (Fig. 1) are denoted by letters (E) through (J) inclusive. Stainless-steel thread inserts will be subsequently installed in tapped holes (M) and (O).

angle-plate which is, in turn, bolted to the face-plate of a Warner & Swasey No. 2A turret lathe. Runout is checked with a dial indicator that is held in contact with the circular lip *D* of the fixture.

Surfaces machined in this setup are denoted by heavy lines at the left-hand end of the part shown in Fig. 2. Cuts are taken at three different levels within the casting. First, the outer flange and face *E* are turned and formed to permit assembly with the main grinder body. Also, hole *F* is bored to a diameter of 1.750 inches, plus 0.001 minus 0.000 inch, after which it is chamfered.

Second, the center wall *G* is bored to 1.203 inches in diameter, plus or minus 0.002 inch, and counterbored. It is then tapped 1 1/4-20 NS-2 to receive a threaded valve-seat. Finally, at the third level within the casting, a 1-inch diameter flat-bottom drill spot-faces spring-seat *H*. After this, a special hollow mill, having a 1 13/64-inch outside diameter and a 1 3/64-inch inside diameter, finishes shoulder *J*, which is to support a cylindrical air screen.

Remaining operations are drilling and tapping and are performed on a Burgmaster vertical turret drill press. This includes two bolt holes *K*, a trigger pivot-pin hole *L*, a filler-plug hole *M* for the oil reservoir, threaded hole *N* for a wick plug, and another threaded hole *O* for the air-line connection. Stainless-steel Heli-Coil inserts are installed in the handle holes that are to receive the filler plug and the air-line connection. They provide maximum thread protection—eliminating thread failure due to stripping, vibration, fatigue, wear, corrosion, or seizing.

Special shop techniques also had to be worked out for machining the air-motor cylinders, Fig. 3, used in the horizontal grinders. These cylinders are rough-machined on a Warner & Swasey No. 5 turret lathe. Ten exhaust slots *P* are then gang-milled in two passes on a Brown & Sharpe No. 12 machine. Following this, eight intake ports *Q* are end-milled in their proper location with respect to the exhaust slots on a Bridgeport milling machine.

Before further operations are performed, the cylinders are stress-relieved. The outside diameter is rough-ground on a Cincinnati No. 2 centerless grinding machine to within several thousandths of an inch of finished size. The inside diameter is then bored concentric with the periphery.

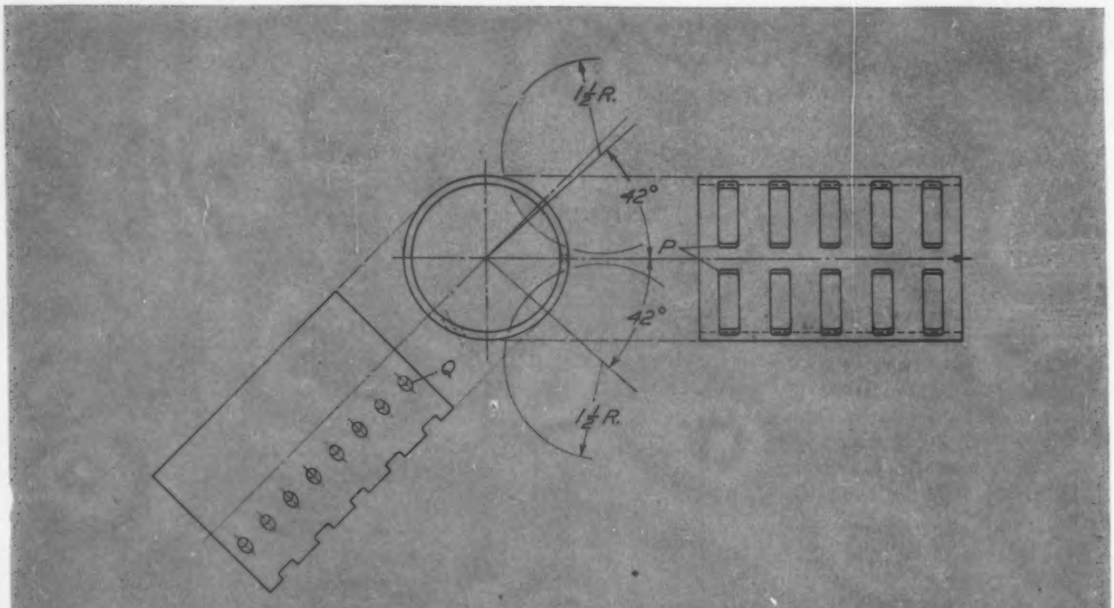
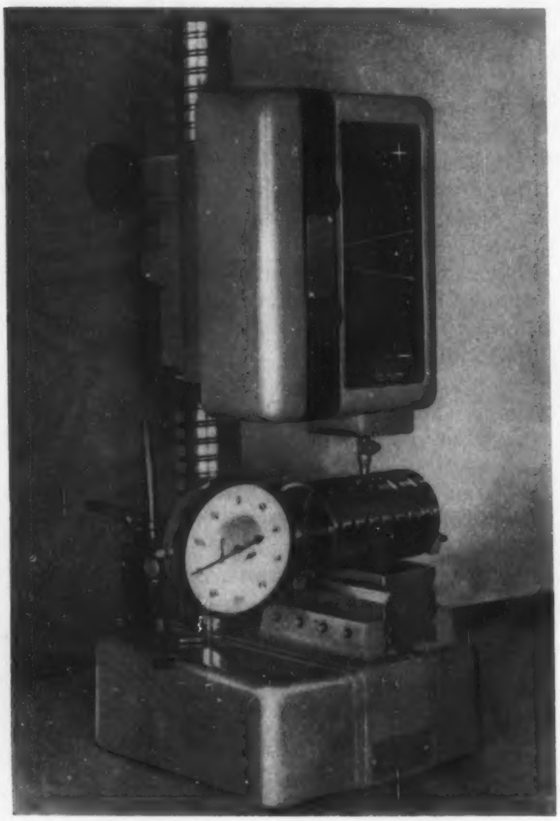


Fig. 3. Cylinder for air-motor is machined by gang-milling exhaust slots (P) and end-milling intake ports (Q) prior to hardening. Finally, the bore, periphery, and two end faces are finish-ground.



Burrs are removed and sharp edges are rounded by abrasive tumbling. After hardening, the cylinders are internally ground and then precision-honed to size. Next, they are mounted on snug-fitting arbors for cylindrical grinding to a diameter of 2.4950 inches, plus 0.0000 minus 0.0005 inch. Wall thickness must be accurately maintained—being held to a dimension of 0.1220 inch, plus or minus 0.0005 inch.

To complete the air-motor cylinders, one end is ground square to the periphery on a universal grinder, and the opposite end is ground parallel on a surface grinder. In Fig. 4 can be seen a multiple-inspection setup on a Pratt & Whitney Sigmatic comparator. The comparator is being used to check the outside diameter for size and roundness within a tolerance of plus or minus 0.0002 inch (note position of the adjustable limit indicators). A dial indicator has been mounted on the comparator column to check length and end squareness within a tolerance of plus 0.001 minus 0.000 inch.

Fig. 4. Mechanical comparator is being employed to check an air-motor cylinder for diameter and roundness to a tolerance of plus or minus 0.0002 inch. Dial indicator (bottom, left) checks length of cylinder and squareness of ends.

Dovetails in Ordnance Parts Now Broached

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ACCURATE DOVETAIL SLOTS of good surface finish are being economically produced by broaching at the Pontiac Motor Division, General Motors Corporation, Pontiac, Mich. The operation is performed on standard broaching machines with special tools and fixtures. For a deep dovetail, an undersize straight-wall slot is milled in a preparatory step. A shallow dovetail, on the other hand, can be broached "from the solid."

Tools are usually made up of several sections, arranged in series in a broach-holder. Where slots are adjacent to each other in a work-piece and are in the same plane, it is possible to broach

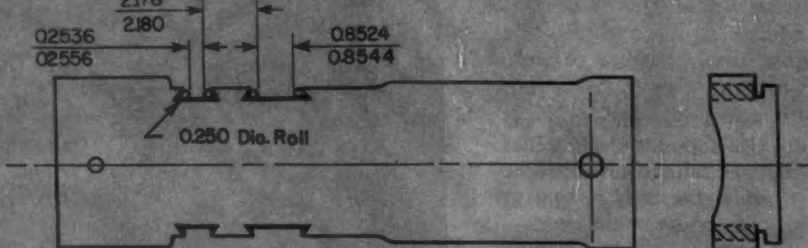


Fig. 1. (Right) Two dovetails are broached in one side of the body, then the body is turned upside down and two more dovetails are broached in the other side.

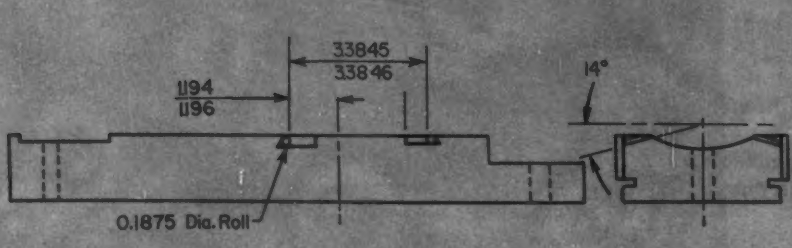


Fig. 2. (Left) Semidovetails are also broached two at a time. Fixture for this operation has pivoting feature to present each angular surface to broaches.

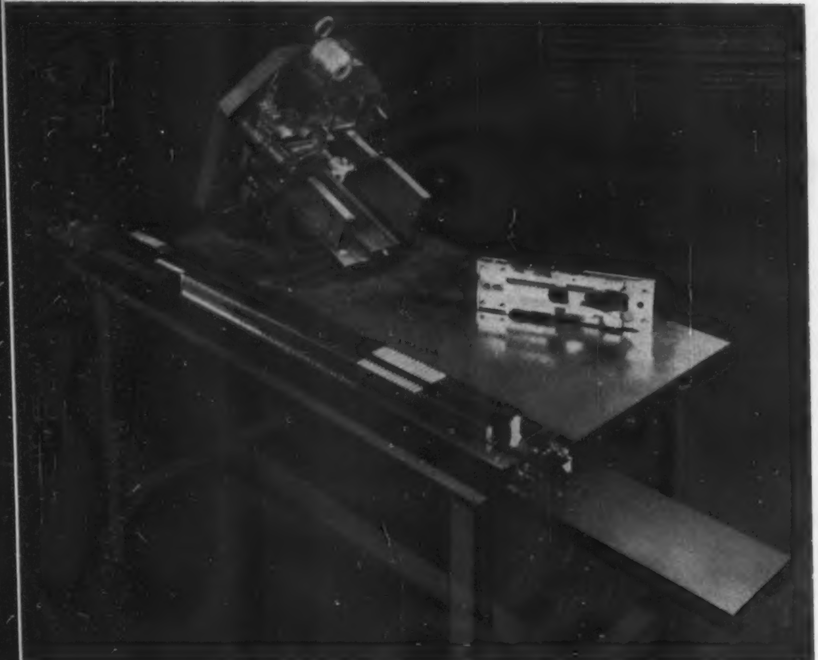


Fig. 3. The two dovetail broaching tools, each made up of five sections, are mounted in the same holder. Finished operating-slide body is also shown on the table.

them simultaneously, thus increasing productivity without increasing labor costs.

An operating-slide body for an aircraft cannon is a typical component in which dovetails are broached. Width and location of the slots are being held consistently within a limit of 0.002 inch. The body is a 4340 forging, hardened to 38 to 42 Rockwell C prior to machining.

Four dovetails are involved, two on each side, as can be seen in the drawing, Fig. 1. In addition, two "semidovetails" are broached in each of two angular faces. Their location is shown in Fig. 2. Each pair of adjacent slots is broached simultaneously on a Lapointe horizontal machine equipped with Red Ring tools and fixtures. All dovetails in a production lot of the parts are completed with one set of tools. Then tools and fixtures are changed and the semidovetails are completed. Broaching rate is 10 feet per minute.

The tools and fixture for broaching the dovetails and one of the operating-slide bodies appear in Fig. 3. The five sections comprising each tool perform these steps: (1) rough the slot bottom, (2) chamfer the edges, (3) rough the slot sides,

Fig. 4. For broaching the semidovetails, the broaches operate in a vertical plane while the body is held at an angle.

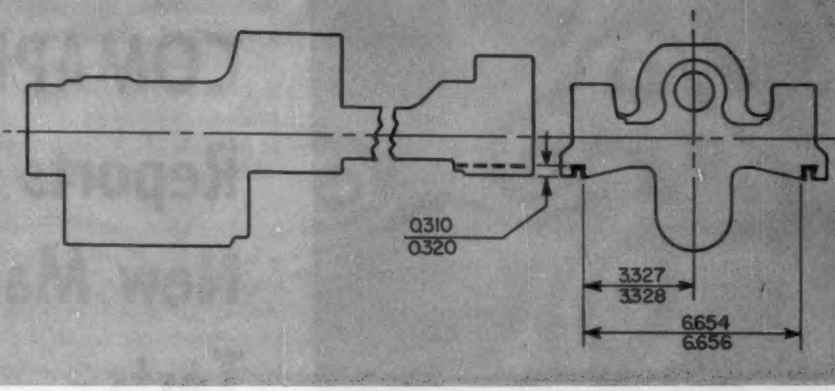


Fig. 5. The two semidovetails in the cradle body drum require separate holders for the broaches because of the distance between them and also because of the shape of the work.

(4) finish the slot bottom, and (5) finish the slot sides and produce the radii in corners.

The body is held vertically on the two uprights of the fixture which form a tunnel over the holder. For locating, a hole near one end of the body fits a dowel pin in the fixture. When properly seated, the work contacts a micro switch, seen on the left of the fixture, which provides a safety interlock in the broaching-machine circuit. After the two adjacent dovetails in one edge are completed, the body is turned upside down and the other two dovetails are completed.

At a later point in the production process, the semidovetail slots are broached. In that setup, the body is held at an angle in its fixture, being pivoted between two positions to produce the two slots in each angular face. In Fig. 4, the machine and tooling are shown part way through the broaching stroke.

Another aircraft cannon part Pontiac is producing, also a 4340 forging, is a cradle body drum. It has a pair of semidovetail slots with chamfered edges, as can be seen in the drawing, Fig. 5. After a preparatory milling step, the slots are completed on the Colonial horizontal broaching machine shown in the heading illustration, also with Red Ring tooling.

The drum is nested on a vee surface and located over a large pin. In this instance, separate holders are used for each broach, and they travel on separate slides, since the two slots are more than 6 1/2 inches apart.

New Type Static-Control Device

Production of a newly developed, static type switching device, called the "Ovitron," has been announced by the Ovitron Corporation, Detroit, Mich. It consists simply of two load-connected electrodes and a grid-control element—all three of which are immersed in an electrolytic bath permanently sealed within an encapsulated container. The device is said to be inherently capable of switching and modulating almost any amount of alternating current endlessly and continuously without wear, disintegration, or loss of efficiency. No moving parts need to be employed. Dispensed with are magnetic coils as well as other bulky and costly amplifying apparatus.

Upon application of a small direct-current potential to the grid element, the two load electrodes become permeable to certain ions and are instantaneously changed from their normally non-conductive state to a conductive state—thus allowing large amounts of alternating current to flow from one electrode to another through the medium of the electrolyte.

The high-wattage load current is controlled entirely by a small direct-current voltage change in a manner which permits either full-on, full-off switching or modulation to occur. Modulation can be continuous without harming the unit.

When the control signal is removed from the grid-control element—or when another signal of opposite polarity is applied—the conductive surfaces of the load-carrying electrodes are immediately restored to their original non-conductive state, thereby effectively blocking the flow of current through the device.

Its simplicity and reliability are said to make it readily adaptable to perform a wide range of high-power alternating-current control functions such as proximity switches, logic devices, modulators, circuit-breakers, error detectors, amplifiers, regulators, and time delays.

COMAPRO Reports on New Machining Tests

DETERMINING the most efficient procedures and materials to be used when producing parts on automatic screw machines is the purpose of "Comapro"—Cooperative Machining Project. Background details of this non-profit research group can be reviewed by referring to July, 1958, MACHINERY, page 165.

Initial tests were made on spark-plug shells, a typical high-production item. A second report, covering the cost analysis and machining development associated with chain-roller production (heading illustration), has now been released. This report, though somewhat limited, may serve to emphasize cost-cutting opportunities within the four main categories of machine down time, namely: job change-over, perishable tool change, lubrication and machine maintenance, and bar-stock loading. Although optimum conditions have not been attained to date in all of these categories, sufficient progress has been made to warrant presentment.

Specified material for the chain roller was 8630 cold-drawn steel bars, 0.6562 inch in diameter. Work was done on a 1 5/8-inch capacity, six-spindle Conomatic with the following simple machining sequence. At position No. 1 the part was rough-formed from the cross-slide and spot- and chamfer-drilled from the tool-slide. Finish-forming and redrilling took place at the second position, with drilling alone being done at position No. 3. In the next step the bushing was again drilled and the outer surface shaved. A recessing tool entered the bore at position No. 5, while the project insignia was rolled on the outside. Reaming and cutting-off were accomplished at the last position.

Job Change-Over—Considerable time can be saved during change-over of jobs that are run repeatedly by using the Comapro-recommended locating-, or reference-, point method. In this system, locating points for tool-holders, attachment heads, etc., are specified by charts in relation to the work-spindle nose and work axis for end-working and side-working tools, respectively. A sample of this chart is shown in Fig. 1. Not only is this system accurate, but it also should save approximately 36 per cent of the job-resetting time normally required if the more orthodox methods were used.

Perishable Tool Change—With conventional type tool-holders it took 77 minutes and 2 seconds to change all eleven perishable tools on the chain-roller job. In comparison, it required only 8 minutes and 3 seconds to accomplish the same change when pre-set, quick-change tool-holders were used. A considerable saving was realized at each tool change, and with no scrap loss.

Lubrication and Machine Maintenance—In the project's work to date on the chain roller, the coolant has been a heavy-duty, soluble-oil type, mixed three parts to twenty parts of water. This mixture was sufficiently rich to improve work finish as well as tool life.

The coolant was maintained at about a 130-

gallon level in the automatic bar machine. During a forty-day coolant test period, approximately 8700 work-pieces were produced. Tests were made at an average room temperature of 76 degrees F., and at an average humidity of 33 1/2 per cent. With the machine in operation, coolant temperature averaged 80 degrees F. At the end of the period, water loss was 35 gallons, and soluble-oil loss was 6 gallons.

All fast-operating units of the machine had the conventional types of bath and forced-feed lubrication that equip machines of the multiple-bar automatic class. At the end of a 720-hour test, lubricant loss from a 15-gallon screened reservoir proved to be only 2 gallons. This was considered to be reasonably economical. On examination, the lubricant appeared to be free of dilution by the coolant.

Up to the time of this report, the machine used for the chain-roller tests has been periodically inspected to determine the contributory cost effects of its performance and maintenance on the work produced. Proper greasing of the slow-moving parts is essential to machine maintenance. An automatic lubricator was used on the test machine to assure adequate attention to these parts. A time study of the pressure-gun method of greasing disclosed that 30 minutes would be required every 16 operating hours for this important machine care.

Bar-Stock Loading—When a continuous type of stock feed is used, such as that illustrated in Fig. 2, there are no pushers or pusher tubes to change. But, when required, there are liners to be inserted or changed in the collet tubes. This type of feed minimizes bar-end loss and down time for restocking the machine. Also, it can effectively make use of random lengths within certain limits. With continuous stock feed, a push-back type of stock stop is used to permit a new bar to dislodge any bar remnant from the collet before the jaws close.

A pusherless type bar feed is efficient either with or without a side-loading, magazine type stock reel, although such a reel can provide additional economies. A side-loading reel will accommodate 20-foot bar lengths in less over-all floor space than is required by a conventional reel for 12-foot lengths. In addition, the magazine serves as a visual gage of the bar stock and eliminates the need for an out-of-stock warning device on the machine.

Chain rollers were produced in a machine cycle time of 8.65 seconds. Using 12-foot-long bars with a conventional stock reel and a conventional pusher and pusher-tube stock feed, the six-spin-

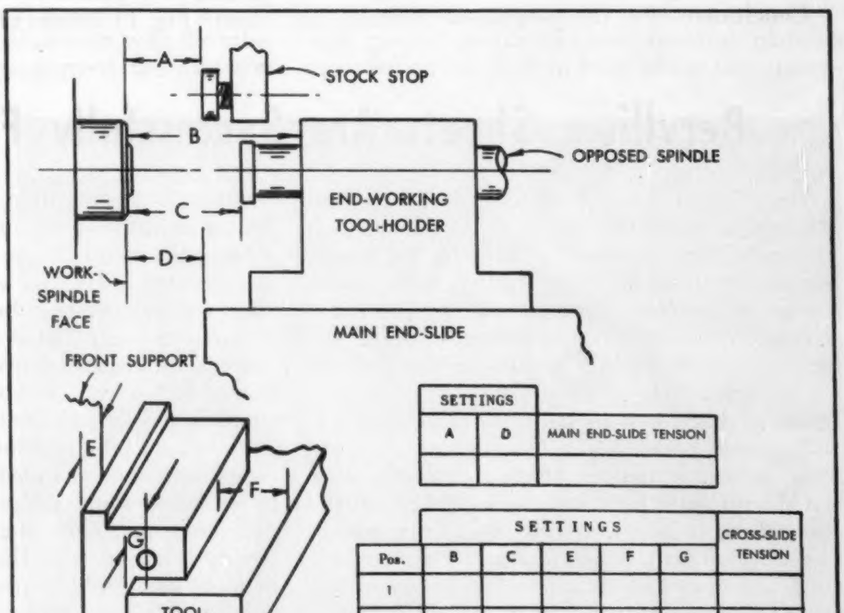


Fig. 1. When any job is to be run repeatedly, much time can be saved by using this Comapro-recommended locating-point chart that is based on machine reference surfaces.

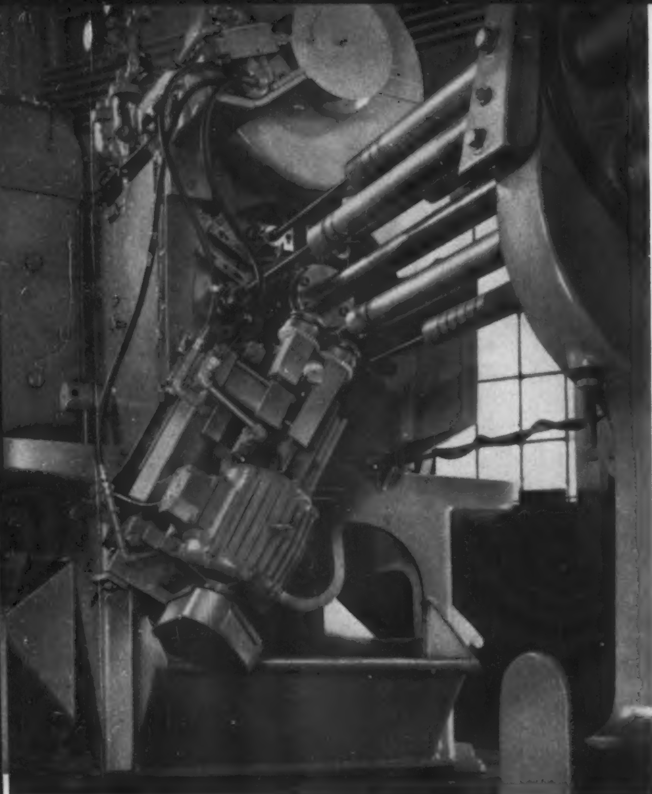


Fig. 2. A continuous mechanical stock feed is being used during this run. This type of feed minimizes bar-end loss and down time for restocking the machine.

dle automatic required restocking three times every 8 hours, or approximately once every 2 2/3 hours. An average of 6 minutes was needed for each restocking.

Conclusions—For the purpose of pointing out cost-saving opportunities only, let it be assumed that all eleven perishable tools on the chain-roller job are changed every 8 hours for optimum low-cost production conditions. At the cycle time of 8.65 seconds per work-piece, 68 minutes and 59 seconds, or 479 parts, were gained per shift by using pre-set, quick-change tool control instead of the conventional tooling method.

At an average of 6 minutes for restocking of the machine, which is done three times every 8 hours, 18 minutes, or 125 work-pieces, were gained by means of continuous stock feeding. On a basis of 30 minutes for hand-greasing the machine once every 16 hours, the automatic lubricator averages a gain of 15 minutes, or 104 work-pieces, every 8 hours. These several factors alone represent a saving of 1.7 production hours, or 708 work-pieces per 8-hour shift.

Savings just concluded are those that can be realized throughout the production run—they pertain to operating factors. A saving not yet broken down is that associated with original machine setup, which occurs only once in each run of a particular part. In retooling the automatic for the chain roller, 45.7 minutes, or 317 work-pieces, were gained by using the reference-point chart (Fig. 1) instead of other means.

Beryllium Sheets Are Successfully Fabricated

The Martin Co., Baltimore, Md., has announced a major technological breakthrough in materials research aimed at keeping the United States ahead in the race toward outer space. Company engineers have successfully fabricated structurally sound beryllium sheet material and have used it to build what has been called the world's first beryllium structure.

Use of beryllium in basic airframe structure will make it possible to solve many of the aerodynamic and structural heating problems associated with space flight and re-entry of the earth's atmosphere at speeds up to 18,000 miles per hour. The development is claimed to be particularly important because airframe material research has not, to date, kept pace with the rapid advancements made in propulsion research. Development and fabrication was performed in conjunction with Nuclear Metals, Inc., Concord, Mass.

Martin engineers said that the combined properties of beryllium are superior to other structural materials from the standpoint of strength, stiffness, heat absorption, and lightness in weight. Its use in airframe manufacturing will enable designers of space vehicles to effect vital savings in weight, fuel loads, and vehicle size. In addition, they pointed out that beryllium structures may not require complicated cooling systems to compensate for structural heating caused by friction during high-speed re-entry. Instead, ordinary insulation may be sufficient.

Until now, all characteristic forms of beryllium —castings, forgings, rolled sheet, etc.—were found to exhibit non-uniform properties and brittleness akin to glass. This stumbling block has been largely removed with the development of sheet material possessing homogeneous properties suitable for structural fabrication.

Other limitations for beryllium usage, however, still remain. Forming or bending of the sheet can be performed only within a finely defined band of elevated temperatures. Also, it can presently be joined only with fasteners, and cannot be fusion-welded.

TOOL ENGINEERING *Ideas*

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

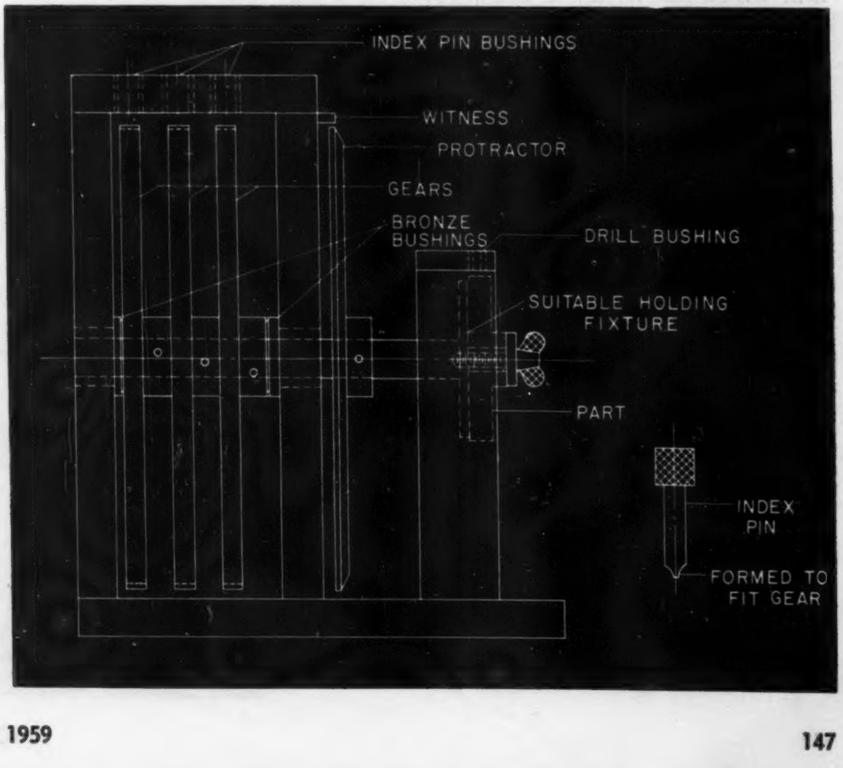
Rapid-Indexing Drill Jig

G. A. Ralston, President
Micro Machine Works, Inc., Roosevelt, N. Y.

The drilling of radial holes at various angular locations around the periphery of a cylindrical work-piece is an operation often required in the shop. The drill jig here illustrated features rapid yet accurate indexing of such parts to speed their production. Although designed to hold work-pieces having a central bore, other clamping arrangements can easily be adapted to the drill jig.

A baseplate made of aluminum supports two uprights spaced sufficiently apart to accommodate three 120-tooth gears mounted on a single shaft. Each of the gears is turned 1/3 of a tooth or 1 degree out of radial alignment with the other two gears. With this arrangement, the center of a tooth space is located at 1-degree intervals around the shaft. Bronze bushings in the uprights are line-reamed to provide a running fit for the gear-shaft. Another plate, positioned across the the top of the uprights, has three drill bushings, each centered over one of the gears. A hardened pin is formed at one end in the shape of a gear tooth and the shank of the pin is made a slip fit in the drill bushings. The tooth-shaped end of this pin, seen enlarged at the right in the illustration, can be engaged with one of the gears to lock the shaft in a known angular position for the required drilling operation.

A plastic protractor and backing plate is mounted on the shaft in front of the forward up-



Drill jig that permits accurate and rapid indexing for producing radial holes in cylindrical work-pieces.

right. The protractor is graduated into 360 degrees in both directions. To facilitate use of the jig, each degree mark on the protractor should be identified in some manner with the bushing in which the pin is to be placed. Consecutive degree marks on the protractor of the original jig were painted blue, red, and yellow, and the colors were repeated in that order until all 360-degree marks were so indicated. The drill bushings were painted corresponding colors so that upon indexing to any particular angle both the mark on the protractor and the bushing in which the pin is inserted are identified by the same color.

The gear-shaft extends a length suitable to accommodate a holding fixture for the part to be drilled and a bushing plate, provided with an appropriate drill bushing, is supported over the holding fixture. With this arrangement, holes can be drilled at any angle, in full degrees, quickly and accurately. In addition, the jig can be used on end with the drill bushing plate mounted parallel to the diameter of the gears.

Tool for Internal Machining of Pressure Vessels

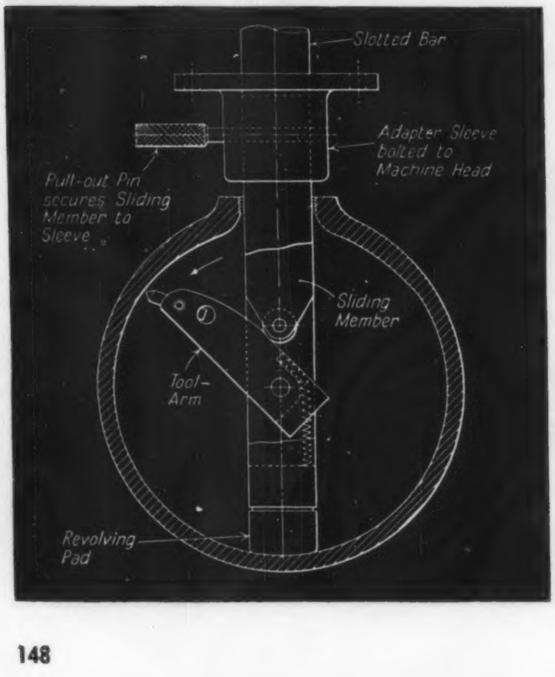
Spherical pressure vessels up to 15 inches in diameter are machined internally with a special bar type tool at the Reynolds Tube Co., Ltd., Birmingham, England. The aluminum-alloy vessels are designed for working pressures up to 4000 psi, and are produced from flat blanks by cupping and press-swaging techniques. With this method of forming, there is a tendency for the internal surfaces in the area of the neck to deform, and in extreme cases, these surfaces may even wrinkle.

Since such deformations are undesirable, the vessels are internally machined by means of the special bar type tool illustrated in the accompanying diagram. The bar clears the bore of the neck and is slotted over the greatest part of its length. Housed within the slot is a swinging tool-arm which has its lower end pivoted on a pin passing through this bar. A tension spring is stretched between one side of the tool-arm and the end of the slot in the bar, so that the arm tends to take a position parallel with the longitudinal axis of the bar.

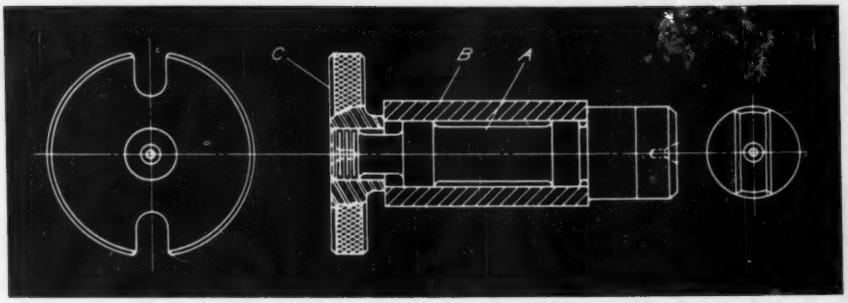
A pad which is free to rotate is mounted on the lower end of the bar. A member carrying a roller at its lower end is mounted so that it can slide longitudinally within the upper portion of the slot in the bar. When the bar is set up on a boring mill, it is held by an adapter sleeve in which it is free to slide vertically. The inner sliding member is secured to this sleeve by a pull-out type pin. When the bar is fed downward through the neck opening, the pad at the lower end contacts the work and movement is arrested. However, the sliding member carrying the roller continues to advance. The roller then engages a cam-profile on the inner edge of the tool-arm and swings the latter about its pivot point so that the cutter describes an arc.

The proportions of the bar are such that the pivot point of the swinging arm coincides with the center of the spherical outer surface. A cut, started on the thickest wall section near the neck, diminishes gradually in depth as the tool-arm is forced downward and outward. By appropriate radial setting of the cutter, the diameter of the area so machined can be varied as required. Also, irrespective of the area covered, the cut will blend smoothly into the surrounding surface of the work-piece being machined.

The work is rotated at 34 rpm and the sliding member is fed at the rate of 0.005 inch per revolution. Usually, the irregularities can be removed completely, by taking three successive cuts, each 0.03 inch deep. After each cut, the tool is reset by making a direct radial measurement from the pivotal center.



A bar type tool has a tool-arm pivoting from a slotted bar, allowing a cutting action that makes the interior surface of the sphere uniform.



Mandrel for production of bushings on a cylindrical grinding machine.

Bushing Mandrel for Cylindrical Grinding

H. J. GERBER, Stillwater, Okla.

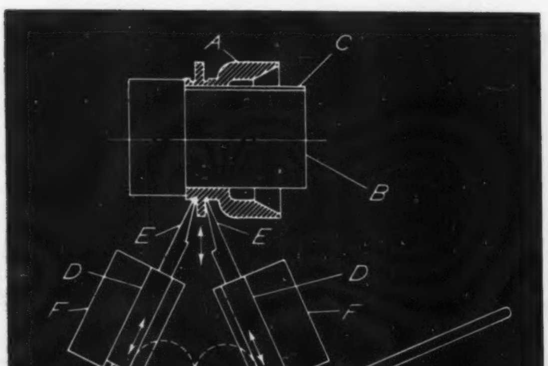
Conventionally, when finishing the periphery of hardened steel bushings on a cylindrical grinding machine, the work-pieces are forced on a tapered mandrel with an arbor press. This process, plus the necessary manipulation of the set-screw on the driving dog, is, at best, time-consuming. When the production of a number of such bushings is required, quick and easy mounting and removal of the work-piece is accomplished by the use of the mandrel here illustrated. In addition, the need for a driving dog is eliminated with this device.

The seating surface of the special mandrel *A* is ground to a snug fit in the bore of the work-piece *B*. This bushing can then be either wrung onto the mandrel if the bore size is at the high-tolerance limit or lightly tapped on if the bore size is at the low-tolerance limit. By relieving the center of the mandrel, accurate seating is obtained and resistance to the mounting of the work is reduced. One end of the mandrel is threaded to receive the driving plate *C*. This slotted, disc-shaped member not only engages with the head-spindle driving pin, but also acts as a nut to secure the work against slippage. The knurled peripheral surface provides an effective hand-grip for loosening and removing the driving plate when required.

A tang, milled on the tail-spindle end, is used, if necessary, as a key for holding the mandrel. When removing tight work-pieces, the tang may be slipped either between the jaws of a vise or in a slotted block mounted directly on the work-table of the machine.

Lever Operates Two Undercutting Tools

GEORGE D. PHEIL, Racine, Wis.



Two quick-acting tool-slides speed a lathe operation of undercutting both sides of a shoulder preparatory to grinding. The work-piece *A*, already faced and bored, fits over arbor *B*. A key *C* engages a keyway to drive the work-piece.

Slides *D*, containing undercutting tools *E*, are mounted in blocks *F* on the lathe carriage. These blocks are toed in toward the shoulder. Each slide is equipped with a gear rack. Lever *G* controls gear *H*, which drives gear *J*, in mesh with the right-hand slide rack. Gear *J*, in turn, drives gear *K*, in mesh with the left-hand slide rack.

Thus, pulling the lever moves both slides in, and the tools undercut the shoulder. Depth of cut is adjusted by stops *L* on the slides.

Pulling lever (G) causes slides (D) to move in, and tools (E) undercut the shoulder.

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the rules

Both subscribers and non-subscribers are eligible. Entries must be *postmarked no later than December 1, 1959.* Mechanism or movement described must have some practical application. No material already described in the technical press can be entered in the contest.

Enter as many articles as you like, but confine each to a single mechanism or movement.

what you do

Send a scale drawing (or photograph—or both) that shows the operating principle and important parts involved. Clear blueprints or pencil drawings are acceptable, but free-hand sketches cannot be used.

Describe the *purpose* and *action* of the mechanism—*how* it does *what* it does. Your description need not be in polished English, but it should be clear and logical.

Mark details on drawing, such as levers, cams, and gears, with letters *A*, *B*, etc., and use corresponding letters to identify those details in the description; thus, "Lever *A* is operated by cam *B*." (A suggestion: See how articles in this issue's "Ingenious Mechanisms" section are handled.)

Substitute a diagram for the drawing, if necessary, to illustrate the arrangement of a complicated mechanism.

what we do

MACHINERY's editors review your entry—thoroughly and objectively—and evaluate it according to its ingenuity and originality. Award-winning articles will be announced in February (1960) MACHINERY.

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INGENIOUS MECHANISMS

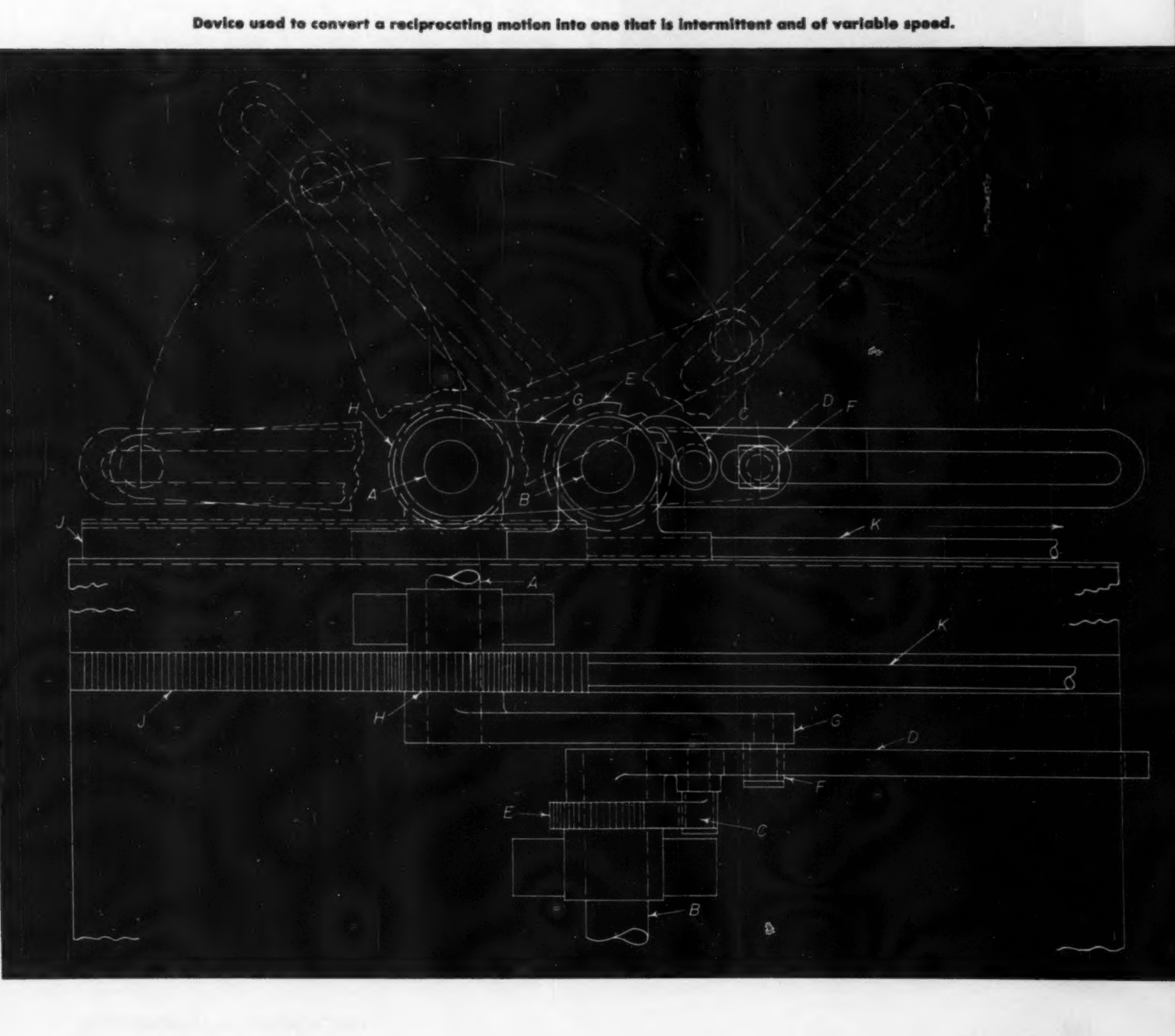
Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

An Intermittent Variable-Speed Movement

L. Kasper, Philadelphia, Pa.

The device here illustrated is used to feed strands of wire at a varying rate of speed through a portion of a machine that produces a woven wire product. A complete feed cycle consisting of a period of movement and an equal period of rest is accomplished by a ratchet and pawl arranged in combination with a pair of levers. The interesting feature of the mechanism is the method of providing the variable-speed motion during the feeding portion of the cycle.

Device used to convert a reciprocating motion into one that is intermittent and of variable speed.



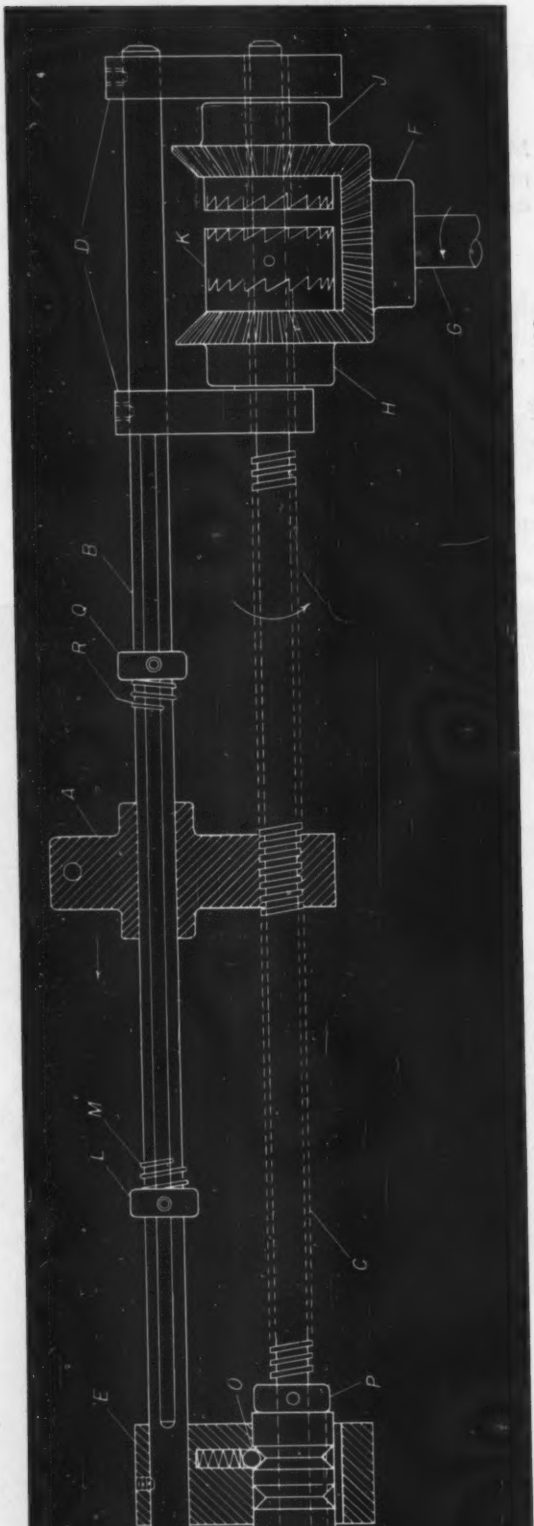
Shafts A and B are both free to rotate in bearings attached to the machine. Pawl C is mounted on a lever D which, in turn, is pivoted on shaft B. A spring (not shown) holds the pawl in engagement with a ratchet wheel E keyed to shaft B. In addition, lever D is slotted to receive a slide-block F. This block is, in turn, pivoted on a stud secured to the lower end of a lever G keyed to shaft A. A gear H, also keyed to shaft A, is constantly in mesh with a rack J, which is fitted into a groove in the machine table for guiding during its reciprocating motion.

In operation, rod K extending from rack J is given a uniform reciprocating motion by another part of the machine. As seen in the illustration, the assembly is at the end of the rest period of the cycle and rack J is about to be moved to the right. This action causes gear H and lever G to rotate counterclockwise, and lever G, through its slide-block and stud, transmits motion to rotate lever D in the same direction. Pawl C then engages the ratchet wheel E and causes shaft B also to rotate in the same counterclockwise direction as levers D and G.

The levers are shown dotted at three positions in their movement. Since they rotate on different axes, there is a continual change in their relative angular positions. This causes slide-block F to move toward the outer end of lever D, thus increasing the length of the effective lever arm. The movement of lever G is uniform throughout the cycle, and therefore, the slide-block transmits a continuously decelerating movement to shaft B until both levers reach the extreme left, where they are in a position of alignment. The rest portion of the cycle is accomplished during the return stroke of rod K by action of the ratchet and pawl arrangement.

Reciprocating Traversing Device with an Adjustable Stroke

ERNEST JONES, New York City



A reciprocating, traversing arrangement having an adjustable stroke for guiding wire onto spools of various widths.

A mechanism designed for leading wire onto a spool in uniform layers is here illustrated. The arrangement incorporates a simple means of producing a smooth, reciprocating motion to the wire guide. In addition, the length of stroke of the guide is easily adjusted to accommodate spools of various widths.

The wire guide A is free to slide on a guide rod B and is traversed by a lead-screw C. Brackets D and E serve as bearings to support both the lead-screw and the guide rod. These brackets also provide a means of mounting the device, but the

details are not shown. A bevel gear *F* is secured on shaft *G*, which is connected to the drive for the wire spool. Two additional bevel gears *H* and *J* are in mesh with gear *F* and rotate in opposite directions on the guide rod. Gears *H* and *J* each have a saw-tooth clutch plate attached to one face. A driving clutch member *K* having teeth on each face is pinned to the lead-screw between the gears. The direction in which the lead-screw is driven depends on the position of the driving clutch member *K*.

In the illustration, part *K* is shown in position to rotate the lead-screw in the direction that will cause the wire guide to move toward a collar *L* on the guide rod. Before reaching the collar, the wire guide compresses a spring *M*. When the spring is compressed, the wire guide stops. However, the lead-screw continues to rotate and moves to the right, pulling sleeve *N* with it, thus lifting a spring-loaded ball *O* out of the right-hand V-notch in the sleeve. A key in bracket *E* keeps the sleeve from rotating with the lead-screw, and two collars *P* pinned to the lead-screw hold the sleeve in place axially.

Once the ball is out of the right-hand V-notch, the pressure of spring *M* on the wire guide will cause both the guide and the lead-screw to move toward the right. This motion will continue until the ball drops into the left-hand V-notch provided in sleeve *N*.

Clutch member *K* will then be engaged with the clutch plate attached to gear *J*, and the lead-screw will rotate in the opposite direction. This will cause the wire guide to move toward Collar *Q* and spring *R*. On reaching spring *R*, the lead-screw reversing cycle is repeated. Collars *L* and *Q* may be placed at any distance apart within the length of the guide rod to suit various spool widths.

The mechanism operates smoothly with just a slight pause before reversal of the wire guide at the end of each stroke. The rapid motion of the guide when the ball lifts out of the notch compensates in part for the pause.

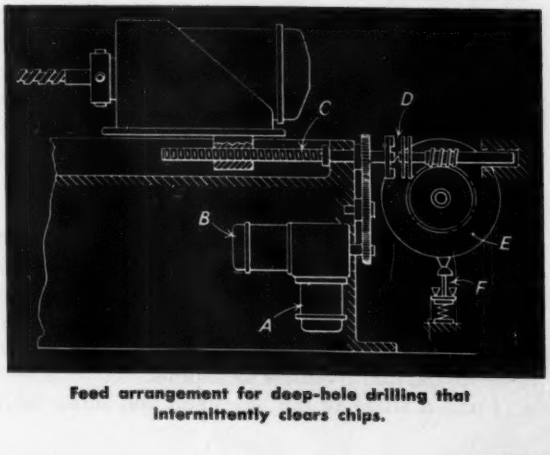
Feed System for a Deep-Hole Drilling Machine

A patented feed system that enables holes to be produced in a deep-hole drilling machine in several stages during an automatic cycle is here illustrated. At the end of each stage the drill head is automatically withdrawn from the work for clearing the chips. Then, the head is returned to the required drilling position under rapid power traverse.

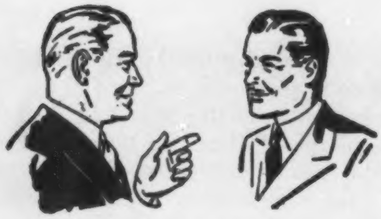
The feed and rapid traverse motions of the drill head are derived, respectively, from motors *A* and *B*, which drive a screw *C* through gearing. Upon completion of each drilling stage, the feed motor *A* is reversed, and, simultaneously, the rapid-traverse motor *B* is brought into operation by the action of a torque control system which is not shown. As a result, the drill head is moved away from the work under rapid traverse. At the same time, an electromagnetic type clutch *D* is brought into engagement. This causes cam *E* to be driven by means of screw *C* through suitable worm gearing.

At the end of the rapid-traverse motion of the drill head, the feed motor *A* is stopped and the motor *B* is reversed, by a means not shown. In consequence the drill head is rapidly traversed towards the work and cam *E* is driven in the opposite direction. When cam *E* has been returned to its original angular position, it operates a switch *F*, with the result that the rapid-traverse motor *B* is stopped, and clutch *D* disengaged. At this point in the cycle, feed motor *A* is again started in order to perform the next stage of the required drilling operation.

Because feed motor *A* is not running during the rapid traverse of the drill head toward the work, when motor *B* is stopped a small clearance exists between the end of the drill and the bottom of the previously drilled portion of the hole in the work-piece. As a result, the risk of drill breakage due to a slight overtravel of the head during the rapid-traverse motion is reduced. The patent for this device also covers feed systems of basically similar design, but wtih separate motor drive for the control cam *E*.



Feed arrangement for deep-hole drilling that intermittently clears chips.



Talking With Sales Managers

By BERNARD LESTER
Management Consulting Engineer

A Growth Program for Sales Engineers

NEW DEMANDS on the machinery sales engineer indicate the desirability of expanding the scope of his basic training. A recent survey by the National Industrial Conference Board revealed that industrial management wants greater sales efficiency in the light of more complex and intense competition, and that, in most instances, the time is ripe for concentrating on sales training more suited to present-day needs.

The growing importance of the machinery sales engineer's job too often goes unnoticed. Today, he must be a professional specialist of pronounced ability in a chosen field. Besides this, he must be familiar with an increasing number of other spheres closely related to his own.

Any Rip Van Winkle awaking from a ten-year nap would be lost in a large metalworking plant today. He would not recognize many a machine tool or process. Words like chipless machining, numerical control, electrohydraulic control, and even ballistic-missile design would not register. Examining a complicated piece of equipment, he would most likely discover it loaded with singular components that are machines in themselves—made by others than the original builder.

And, if our Rip Van Winkle tried to apply and sell machinery, what would he know about the latest accounting methods used both for production and for equipment replacement? The intricate calculating and recording devices now used would baffle him.

He would be confused by manifold buying practices, altered safety regulations, and labor union restrictions. Imagine his surprise over the vast peacetime government purchases which support unheard-of fabricators. What would he know about current government electronic and atomic needs?

To progress in our radically changing environment, we need to develop salesmen who are much more than friendly emissaries who have learned what to say and what not to say. We need sales engineers who bore in more deeply than formerly, and who judge wisely in a variety of technical and business situations.

"From a study of our salesmen and those who call on us, I find too many who go through the how-to-sell routine they have been taught. When it comes to the careful analysis of a fresh technical problem, or presenting new ways to solve an existing one, many of them get lost, and lose business." This statement, made to us by an executive of a well-known machinery builder, is very apt. Further discussion with this gentleman about revamping the approach to sales-engineer training brought out these points:

1. The friendly "price-and-delivery" salesman, though he is familiar with all selling points, is not adequate. Present day customers don't welcome him as they once did. He must have the third dimension: *depth*—the power to penetrate a process and initiate new methods.

2. Greater emphasis in the future will be placed on selecting candidates with the ability to grow. In the rush to get sales help, the tendency has been to accept the run-of-the-mill engineering graduate, then dress him up as a salesman and place him in the field. In the future, sales engineers of greater stature will be needed; not patterned and cast, but individually wrought.

3. The educational requirements for sales engineering have gone up a great deal in recent years. Our search for talent must extend beyond the four years in a technical school. Maturity to tackle industrial production problems with breadth of view and depth of penetration must be acquired by post-graduate training.

4. The need for generalship grows more acute. We don't mean the ability to command others, but the power to draw upon other experts and coordinate their skills in building sales.

5. To meet future requirements, besides revising our past method of selecting talent, the way we train sales engineers must be much more thorough and inclusive. It will be more carefully tailored to the man and to the work.

Our talk with this mature executive convinced us of the importance of examining training schedules, and of setting up a growth program for each sales engineer as well. These are vital objectives if sales management is to keep abreast with the demands of a new manufacturing world.

Selecting Ball Bearings for Machine Tool Spindles

Proper selection and correct arrangement in mounting are essential to the performance of ball bearings on machine tool spindles. These tasks become more complicated as ever-greater demands are made on the various machine tools being used by modern industry today

RONALD W. MORAN, Engineering Manager
Precision Applications
Fafnir Bearing Co., New Britain, Conn.

September 1959

Selecting Ball Bearings for Machine Tool Spindles

WORK AND TOOL SPINDLES are functionally the most important members of machine tools. Consequently, in the attainment of specific requirements for spindle speed, work accuracy, and finish, the selection of the proper size and type of bearings to support these spindles is a critical design problem.

Many considerations are involved in the choice of bearings for precision applications. Among those which influence the performance of machine tool spindles are the internal fit-up and geometry of the bearings, the mounting arrangement, the shaft and housing mounting fits, the balance and alignment of the rotating parts, and last, but equally important, the lubrication. While many of these factors are significant in slow-speed applications, all of them must be considered for high-speed spindles.

Properly designed shafts for machine tool spindles are of generous cross-section and comparatively short. This is done to minimize deflection under load. For the same reason, spindle housings are designed heavy enough to carry the work load. Their cross-sections are made as uniform as possible to reduce stress concentration and uneven deflection of the frame due to thermal changes. In addition, heavy, well-proportioned housings can function as sinks to conduct heat away from ball bearings.

Tolerances for Ball Bearings

The Annular Bearing Engineers' Committee has established and standardized five classes of tolerances for ball bearings, known as ABEC-1, ABEC-3, ABEC-5, ABEC-7, and ABEC-9. The highest number indicates the class with the most exacting tolerances. Generally, ball bearings for machine tool spindles are made to ABEC-7 tolerances. Ball bearings made to considerably closer tolerances than Class 7, however, are employed for applications such as precision work-heads and wheel-heads.

In Fig. 1, the chart shows the various classes of tolerances for 35-millimeter bore size, light-series ball bearings. To meet the requirements of the machine tool industry, even ABEC-9 tolerances do not represent the ultimate, since some special applications warrant still higher precision.

Types of Mounting Arrangements

Ball bearings for machine tool spindles must support radial loads combined with thrust loads in either direction. For this reason, preloaded, angular-contact bearings of either light or extra-light series are generally used. Such bearings, having a maximum number of balls, are most suitable from the standpoint of capacity and rigidity. In addition, they are preloaded to reduce axial and radial deflections and may be mounted in three different arrangements—back-to-back, face-to-face, or tandem—as illustrated in Fig. 2. The bearings may abut each other or may be separated by parallel spacers or sleeves of equal length. Some mountings have multiple sets of three or more matched bearings, depending on the requirements of the spindle. For extremely high-speed applications, ball bearings are usually mounted singly and preloaded by springs.

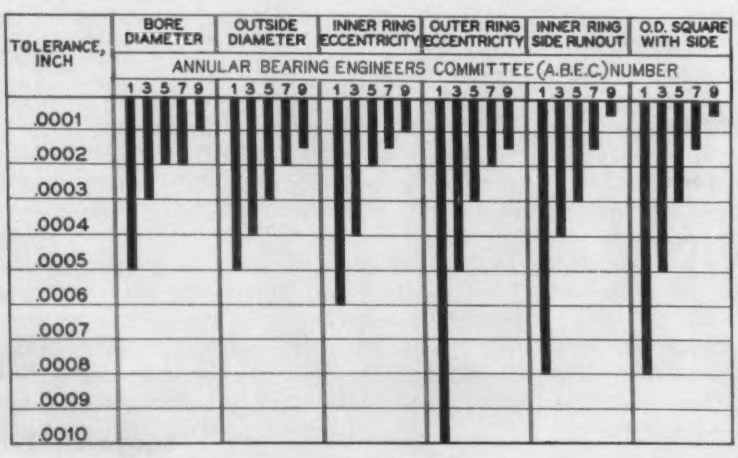


Fig. 1. Tolerances of 35-millimeter bore, light-series ball bearings for classes established by Annular Bearing Engineers' Committee. Ball bearings for machine tool spindles are generally made to ABEC tolerances.

In back-to-back (DB) mountings, the most commonly used, the wide faces of the bearing outer rings project beyond the inner rings and abut each other. The angular lines of contact of these bearings diverge in the direction of the rotational axis, resulting in both axial and radial rigidity for the shaft and providing maximum resistance to deflection. Upon clamping the inner rings together by tightening the bearing locknut, a load is imposed through the balls and the outer rings. This takes up the internal clearance and places these members in compression. The initial amount of offset or clearance between the inner-ring faces, therefore, determines the amount of preload.

When bearings are mounted face-to-face (DF), that is, with the narrow faces of the outer rings together, the angular lines of contact of the bearings converge in the direction of the rotational axis and the inner rings project beyond the narrow faces of the outer rings. When the outer rings are clamped together, the initial clearance between the outer rings is taken up, preloading the bearings. Mountings of the DF type can be used only at the fixed bearing location of the spindle. These mountings are warranted for particular conditions of bearing assembly and removal, and offer some facility in certain applications.

Duplex preloaded bearings mounted in tandem (DT) divide the work load between the bearings. So arranged, with the angular lines of contact of the bearings parallel and in tandem, they must be opposed by another bearing, or a pair of bearings, to provide axial stability to the mounting.

Where the load conditions are unusually heavy, two pairs of bearings are used at the work end of the spindle. The same is true of machines designed for a diversification of work over many speed ranges and operating loads. In such cases the bearings are mounted DT DB—two tandem pairs of bearings used in back-to-back arrangement.

For high-speed applications, radial and axial rigidity and smooth spindle performance may be obtained by spring-loading the ball bearings with a predetermined thrust load. Spring loading allows the spindle to float laterally during temperature changes without appreciably increasing or decreasing the original thrust load.

Radial expansion of the inner ring, due to heat generated at the bearing or an interference shaft fit, is compensated for by the deflection of the spring. The balls are thus allowed to assume a slightly different contact angle with practically no change in the preload.

In some applications, single, spring-loaded bearings are employed at the front and rear locations, mounted in back-to-back arrangement. Other mountings, similarly spring-loaded, have a pair of bearings installed in tandem at each end of the spindle in back-to-back arrangement (DT DB). In either case, the spring pressure is applied to the pulley end or rear bearing position, placing the shaft in tension between the two bearing locations.

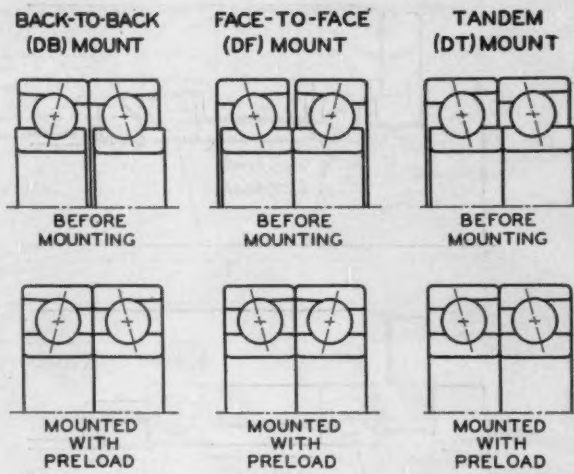


Fig. 2. Three basic mounting arrangements for ball bearings. In preloading, they are clamped together, bringing both inner and outer rings into alignment. The initial offset between these ring faces therefore determines their design preload.

Back-to-Back versus Face-to-Face Mountings

Mountings having bearings applied in any of the face-to-face (DF) arrangements are objectionable because they provide the least rigidity. Furthermore, when the operating speeds are comparatively high, such mountings may build up bearing preload excessively because of the temperature gradient between the housings, bearings, and shafts. As this gradient increases, the bearing preload builds up, starting a vicious cycle which may lead to premature spindle failure.

In spindle mountings, the shaft usually changes in temperature at a faster rate than the housing, creating temperature differentials between the two members. Such differentials are due to their difference in mass and their respective abilities to act as heat sinks. Thus, the shaft and the inner-ring spacer expand at a faster rate than the housing and the outer-ring spacer. As the shaft expands longitudinally and the inner-ring spacer

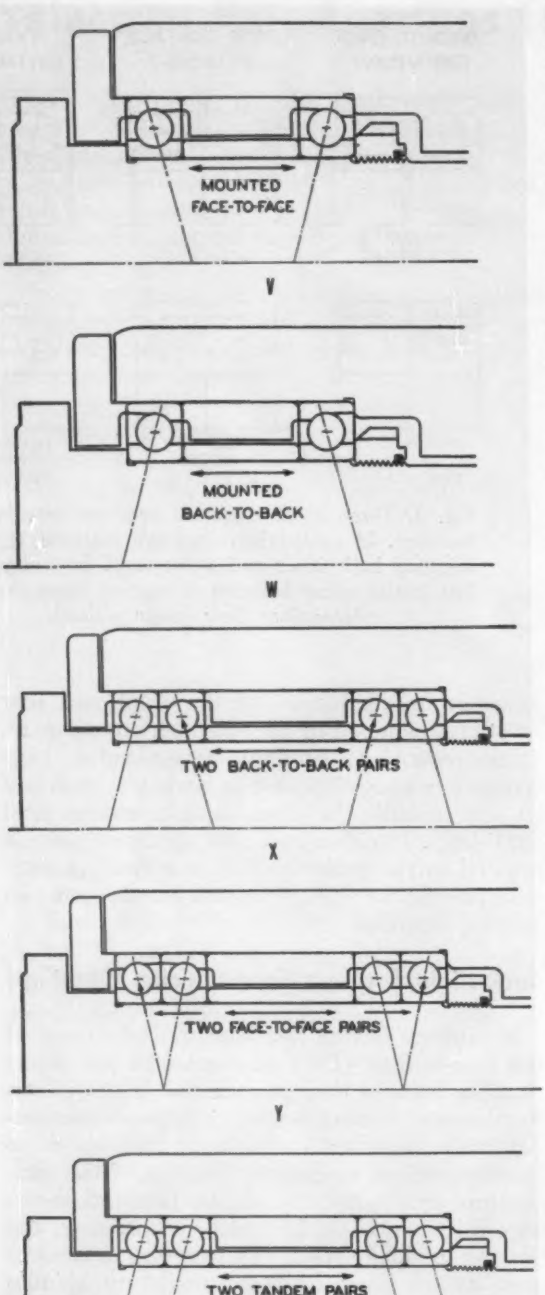


Fig. 3. To prevent increases in preload due to thermal expansion, back-to-back mountings are preferred for bearings on machine tool spindles. When two pairs of bearings are used, each pair should be mounted in tandem but the combination arranged back-to-back (View Z).

lengthens, a thrust load builds up on each bearing and continues to increase until the equilibrium temperature is reached. This occurs when the temperature at the housing levels off and the heat transferred from the bearings balances the heat generated in them. Therefore, if the housing attains an excessively high temperature, the initial bearing preload is built up considerably.

In a face-to-face mounting (Fig. 3, View V) the shaft expands radially and longitudinally and the inner-ring spacer lengthens, but at a faster rate than the outer-ring spacer. This thermal expansion causes an additional thrust to be imposed on both inner rings, increasing the preload of the bearings. Conversely, in back-to-back mounting (Fig. 3, View W), the longitudinal expansion of the inner-ring spacer tends to relieve, rather than build up, the bearing preload.

The two back-to-back pairs shown in Fig. 3, View X are mounted so that the two middle bearings are face-to-face. As previously observed, temperature differentials cause the preload of these inside bearings to increase during operation. In bearing mountings of the type seen in Fig. 3, View Y, undue thrust loads are imposed on the two outside bearings as the temperature along the shaft becomes higher than at the housing. This, in turn, unloads the two inside bearings and starts a vicious cycle of increasing temperature, preload build-up, and lubricant depletion. The same bearings are shown correctly mounted in tandem and arranged back-to-back in Fig. 3, View Z. Lateral expansion of the shaft and inner-ring spacer of such mountings increases neither thrust loading nor bearing preload.

Preloading Decreases Deflections Due to Operating Loads

Ball bearings that are to be mounted in any of these arrangements are preloaded and duplexed for universal mounting. The advantage of preloading is that deflection decreases as the load increases. Duplex bearings are preloaded at the factory with a predetermined thrust load. When clamped together, their parts are subjected to compressive forces, bringing the balls into contact with their respective raceways, taking up initial clearances. Thus, the preload that was built into the bearings is automatically obtained. The condition of a preloaded ball bearing is similar to that of one in operation under thrust load. This initial thrust load serves to decrease, markedly, the axial and radial deflections when subsequent operational loads are imposed on the bearing assembly.

Bearings are preloaded no more than neces-

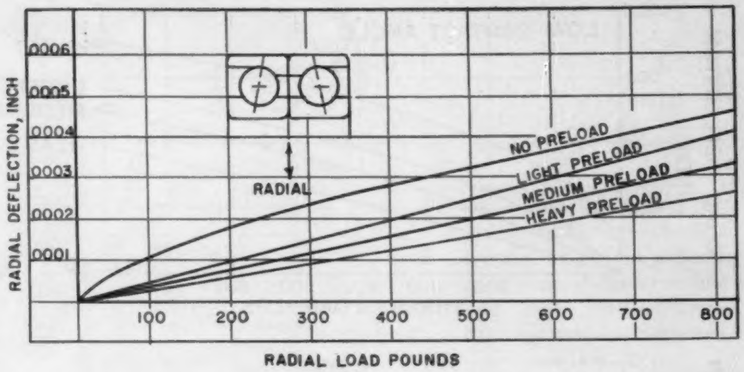


Fig. 4. Graphs of radial deflection versus radial load for pairs of one particular size of angular-contact ball bearings. Curves are for pairs designed for each of three classes of preload and no preload.

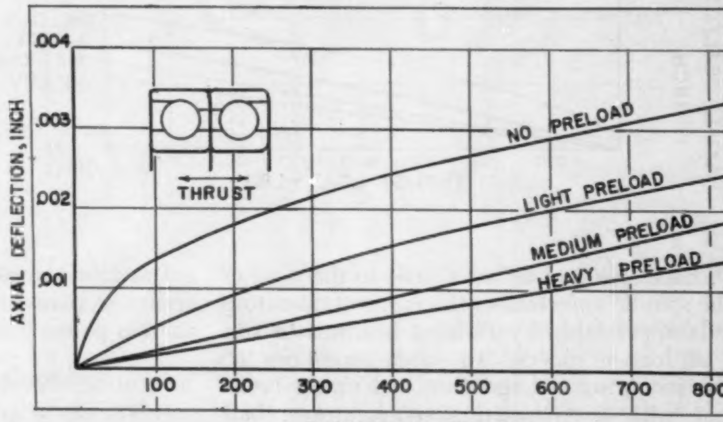


Fig. 5. Axial deflections plotted against axial loads for bearings under consideration in Fig. 4.

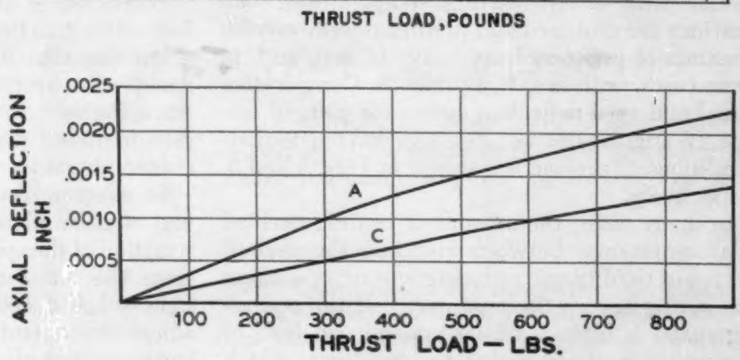


Fig. 6. The axial and radial deflection characteristics of light-series, preloaded ball bearings having a low contact angle. Curves (A) and (B) are for a single bearing while (C) and (D) are for a pair of bearings mounted in tandem.

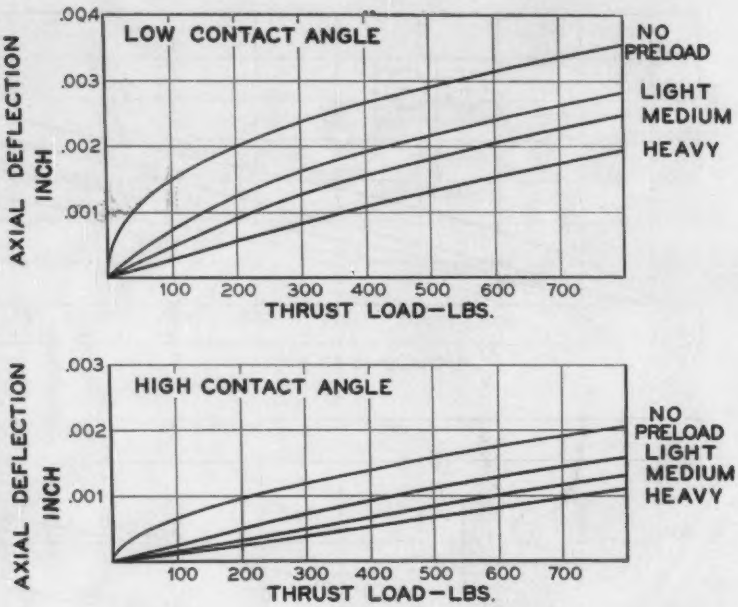


Fig. 7. Here, the deflection characteristics of preloaded, light-series bearings having a low contact angle (top graph) are compared with those of bearings of the same size and type but having a high contact angle (lower graph). Axial deflections are plotted against axial loads in these two graphs.

sary. Excessive preload adds little to the rigidity of the spindle and reduces the range of operating speeds appreciably by causing bearings to run hot at higher speeds. To meet conditions of speed, mounting arrangement, and rigidity consistent with low operating temperatures, ball bearings are designed and produced with varying amounts of preloads from heavy to zero and, in some cases, with negative preloads. Comparative radial and axial deflection curves for pairs of one size of angular-contact bearings having various conditions of preload are shown in Figs. 4 and 5, respectively.

In many cases, the amount of bearing preload is a compromise between attaining the desired degree of rigidity and reducing any adverse effect preloading has on the equipment. If the operating speed is high, a heavy preload can lead to excessively high operating temperatures, which may result in early bearing failure. For these reasons, three classes of ball-bearing preloads are used—light, medium, and heavy. In certain applications, such as high-speed motorized router spindles, specially preloaded, super-precision ball bearings are required. Such bearings are "zero" preloaded—that is, the faces of the inner and outer rings are ground flush under negligible load.

To insure accurate mounting of duplex, super-precision ball bearings, the high points of radial eccentricity are marked on the faces of their inner and outer rings. In addition, these bearings are matched to within one-half the required tolerance on bores and outside diameters, and packaged in pairs.

Angular-Contact Bearings

Ball bearings are available with both high and low contact angles. Each type has inherent characteristics that are desirable for machine tool spindles. A bearing having a low contact angle has a higher rate of axial deflection and a lower rate of radial deflection than one with a high contact angle.

In selecting the proper size and type of bearing, consideration is given to the size and construction of the spindle and the kind of mounting, since the latter relates directly to the spindle rigidity and deflection characteristics. In general, where the operating load is principally radial, low contact-angle type bearings are selected, but where the loading is chiefly in thrust and a high degree of axial rigidity is required, higher contact-angle type bearings are recommended. Therefore, for the majority of applications, super-precision ball bearings with low contact angle are used. However, when maximum axial rigidity is required in combination with heavy thrust loads or when high ambient temperatures are involved, bearings having the larger contact angles are preferred. The three established preload (class) values are necessarily higher for high contact-angle bearings than for those having low contact angles.

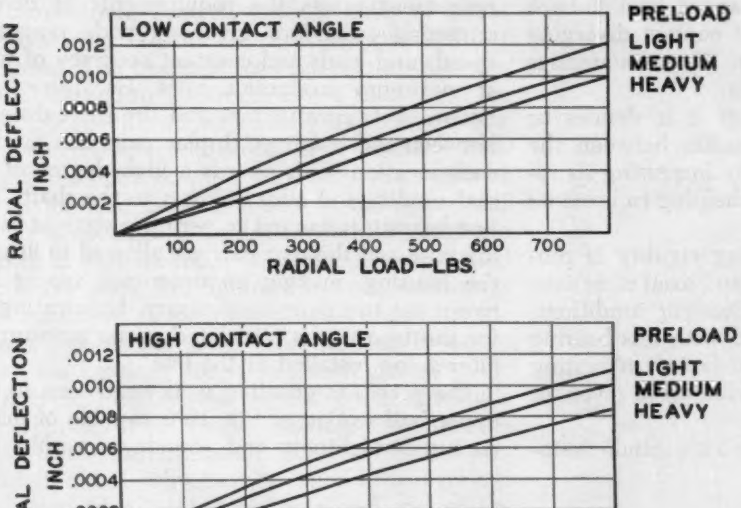


Fig. 8. Graphs showing the radial deflection characteristics at various preload conditions of the same low and high contact-angle bearings that are compared in Fig. 7.

The axial and radial deflection characteristics of low angular-contact, light-series, preloaded ball bearings of a standard size are shown in Fig. 6. Curves *C* and *D*, which are for a preloaded tandem pair of such bearings, indicate the greatly reduced axial and radial deflections as compared to those for a preloaded single bearing of the same size (curves *A* and *B*). For example, a tandem pair of bearings under a thrust load of 600 pounds would have an axial deflection of 0.0010 inch, while that for a single bearing would be about 0.0017 inch. Similarly, the radial deflections for these bearings operated under 600-pound radial loads would be 0.00024 inch and 0.00049 inch.

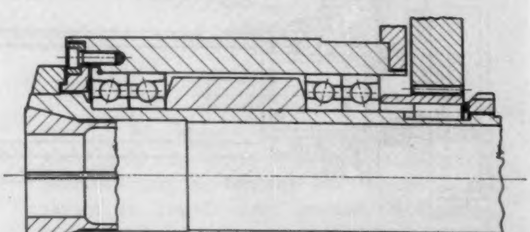
Axial deflection characteristics for low and high angular-contact, light-series, ball bearings identical in size but having various preloads are given in the two graphs in Fig. 7. A comparison of these curves shows that increased axial rigidity is offered by the high contact-angle bearings. For example, in the case of bearings having identical preloads of 125 pounds and operating under a work thrust load of 200 pounds, the axial deflection would be 0.00055 inch for a low contact-angle, heavily preloaded bearing, and 0.00033 inch for one having a high contact angle and a medium preload.

Similar comparisons of the radial deflection characteristics of the same two types of angular-contact ball bearings can be made from the two graphs seen in Fig. 8. These curves show that reduced radial deflections result when bearings having the higher contact angle are used. The indicated radial deflections are for one bearing. When employing duplex pairs of bearings under equal, applied radial loads, the radial deflections would be approximately one-half of the values shown.

Typical Mountings

Ball bearings, either single or in pairs, may be spaced apart by means of parallel, equal length, inner- and outer-ring sleeves. In such applica-

Fig. 9. Construction of a spindle for a six-spindle automatic screw machine. Two back-to-back pairs of bearings are used, the rear pair being allowed to float in the housings.



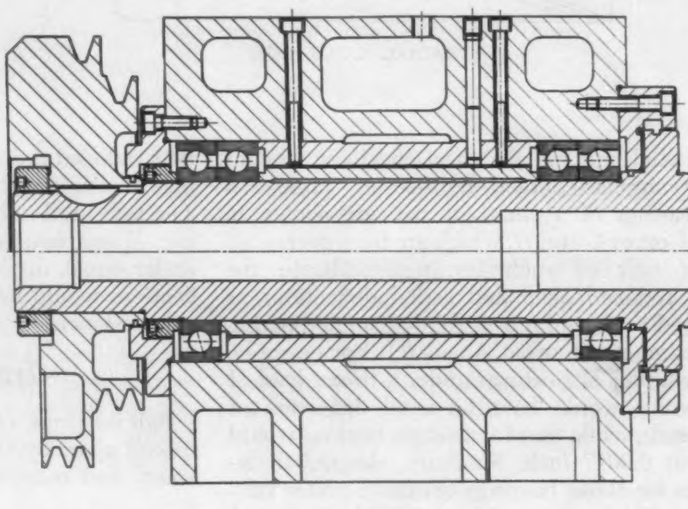
tions, the bearings are mounted back-to-back (DB) or as tandem pairs arranged back-to-back (DT DB) with their lines of contact diverging in the direction of the shaft. These mountings have the following advantages:

1. The shaft, particularly if it is slender or hollow, is placed in tension between the bearing locations, thereby increasing its resistance to bending and helping to promote smooth running.
2. A high degree of bearing rigidity is provided in both the radial and axial directions under a wide range of loading conditions.
3. Good rigidity is obtained with less bearing preload. In this way, satisfactory operating temperatures may be maintained even at high spindle speeds.

The spindle construction for a six-spindle automatic screw machine is shown in Fig. 9. This arrangement meets the requirements of diverse operating conditions involving wide ranges of speeds and loads and constant accuracy of work at maximum production rates. Because of the hollow shaft construction and the short distance between the bearings, duplex pairs are used at each location. This affords a high degree of radial rigidity and adds stiffness to the shaft. The first bearing is flanged to permit a straight housing bore and the rear pair are allowed to float in the housing, making an outer-ring spacer between the two pairs unnecessary. Lubricating oil for the bearings is circulated under pressure, a filter being installed in the line.

The precision grinding work-head seen in the upper half-section of Fig. 10 is capable of maintaining straightness and roundness within ten

Fig. 10. (Right) Arrangement of ball bearings in work-heads for precision grinding. The upper half-section shows duplex tandem-mounted bearings for heavy-duty operation. The single-bearing mounting seen in the lower half-section is for lighter-duty applications.



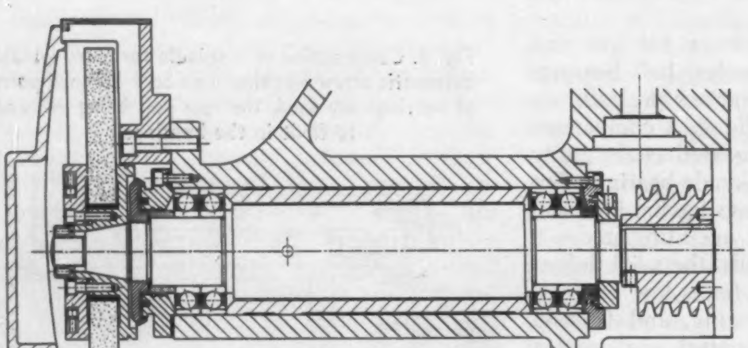


Fig. 11. (Left) Preloaded back-to-back pairs of bearings support this spindle for a toolroom surface grinder. The outer sleeve is doweled to the housing near the wheel-end bearings and the rear bearings float axially to compensate for unequal thermal expansion during operation.

millionths (0.000010) of an inch. For this degree of dimensional control, tandem pairs of ultra-precision bearings and a shaft of extra stiffness are used. The bearings for such applications are manufactured to tolerances closer than those for ABEC-9 specifications. Equally important is the high degree of workmanship and accuracy with which the shaft, housing, and component parts of the work-head must be made. In the upper half of the cross-section, duplex tandem bearings are shown at each location. This arrangement is used for heavy work. For lighter duty, single bearings are employed at each location, as shown in the lower half of the same cross-section. In either case, the bearings are packed with grease.

A typical high-speed internal-grinding spindle incorporates two single bearings mounted in back-to-back arrangement. The bearings are pre-loaded, often with a nest of coiled helical springs in a cartridge located at the wheel end of the spindle. The thrust load exerted by the springs assures that the balls contact the raceways under all operating conditions and also places the portion of the shaft between the bearings in tension. Construction of the spindle must provide protection against the intrusion of coolant and foreign matter. For lubrication, the bearings are packed with grease prior to mounting.

The toolroom surface grinder spindle shown in Fig. 11 is mounted in duplexed, super-precision, preloaded bearings. This arrangement provides the necessary rigidity in both directions and performs well at low operating temperatures. The housing is bored straight through to eliminate shoulders and help assure alignment. Although the outer sleeve is doweled to the housing to stabilize the spindle axially at the wheel-end bearing, the rear bearings are allowed to float and thus compensate for size variations due to thermal changes. In this application, the bearings are also grease-lubricated.

A router, driven by a 30-hp motor at speeds up to 15,000 rpm, is shown in Fig. 12. Matched light-series, angular-contact, duplex ball bearings with zero preload are mounted back-to-back at the work end of the router spindle. This mounting affords the rigidity necessary for routing through aluminum plate 1 inch thick with a single pass. The upper bearing is spring-loaded and permitted to float. Oil-mist lubrication is employed.

Mounting Fits Influence Bearing Preload

Housing and shaft mounting fits are extremely important in the proper application of ball bearings. The bearings, shaft, and housing must be rigid over a wide range of speeds and loading

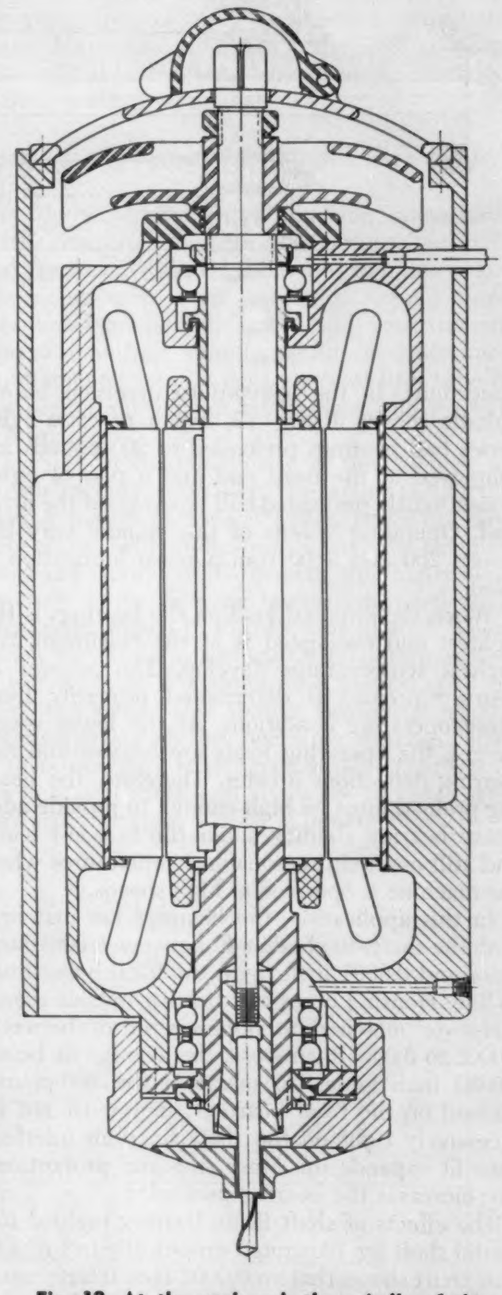


Fig. 12. At the work-end, the spindle of this high-speed router is mounted in specially matched angular-contact ball bearings designed to provide zero preload. A floating spring-loaded bearing is employed to support the upper end of this precision spindle.

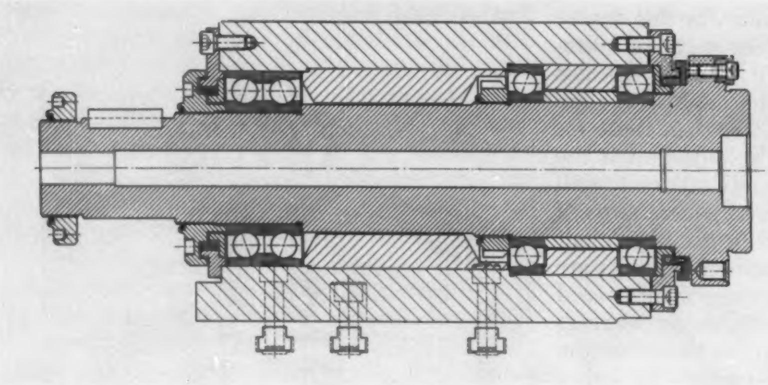


Fig. 13. Spindle used for precision boring. The bearings are preloaded to provide sufficient rigidity under heavy loads and yet not overheat when the machine is operated at high speeds.

conditions. In the heavy-duty precision boring spindle shown in Fig. 13, a pair of extra-light-series ball bearings preloaded to 200 pounds are employed at the front end and a pair of light-series, lightly preloaded ball bearings, at the drive end. Operating speeds of this spindle vary between 200 and 3000 rpm. Grease lubrication is used.

When the imposed load on the bearings is the lightest and the speed is at the maximum, the highest temperatures develop. The amount of bearing preload is determined primarily from these operating conditions. At the lower speed ranges, the operating loads are heavier and the bearing deflections greater. Therefore, the bearing preload must be high enough to provide adequate bearing rigidity under the heaviest loads and still maintain reasonable temperatures when the machine is operated at high speeds.

In this application, the bearings are matched with the shafts to obtain a fit between 0.0001 inch loose and 0.0001 inch tight, the ideal being line-to-line. Housing bores and bearing outside diameters are matched to obtain a fit of between 0.0002 to 0.0005 inch loose, the average fit being 0.0003 inch loose. To maintain the 200-pound preload on the front bearings, they must not fit excessively tight on the shaft since an interference fit expands the inner ring and proportionally increases the bearing preload.

The effects of shaft fit on bearing preload for a solid shaft are illustrated graphically in Fig. 14. This chart shows that an 0.0002-inch interference fit increases the initial preload of the bearings used from 200 to 325 pounds and an 0.0005 inch interference fit increases it to 550 pounds.

When ball bearings are spring-loaded and the inner ring is expanded by an interference fit on the shaft, the preload does not build up because the resultant change in spring pressure is negligible. For this reason, in some spring-loaded applications where the thrust is principally in one direction, bearing lock-nuts are eliminated and the interference fit is depended upon to secure the inner rings on the shaft. Such arrangements allow the bearings to be located closer to the work and eliminate the necessity of lapping or scraping of lock-nuts.

Heat Generation

When ball-bearing spindles are grease-lubricated, the heat generated is removed only by conduction through the surrounding parts. With jet or circulating oil lubrication, generated heat is dissipated by the oil passing through the bearings as well as by conduction through the shaft and housing. Both means of removing heat from the bearings are important but, generally, dissipation through conduction is less obvious.

As an example, in an oil-mist-lubricated grinding spindle the nose or wheel-end bearings are fixed and close to the grinding coolant. The pulley end or rear bearings are secured axially on the shaft but permitted to float laterally in the housing to compensate for size variations due to thermal changes. Heat is conducted away from the front bearings at a faster rate because of the mass of the spindle nose and the intimate contact of the outer rings with the housing shoulder, the end cover, and the housing bore. This conduction, coupled with oil-mist lubrication and the proximity of the grinding coolant, takes away generated heat efficiently.

The rear or floating pair of bearings are not so favored. Usually, the mass of the shaft at the pulley end is not great. The pulley possesses some heat-conduction ability but also receives heat generated by belt friction. The bearing outer rings do not contact the housing or the end cover. Thus, dissipation of heat is limited to the passage of oil through the bearings and to conduction at

the periphery of the outer rings and the housing.

Low operating temperatures, combined with adequate spindle rigidity, are important and highly desirable for precision machine tools. This is particularly true for high-speed grinding spindles where the preload of the bearings is the principal load imposed upon them. Some of the benefits derived from low operating temperatures are better dimensional stability of the processed work, less need for bearing lubrication, prevention of objectionable heat at the external surfaces of the spindle housing, and elimination of troubles due to thermal effects on mounting fits and preloads.

The heat developed at the ball bearings under load is a function of the operating speed and the bearing preload. Preloading is necessary for maximum axial and radial rigidity. Unfortunately, if speeds are increased, the bearing preload may have to be lessened to maintain proper operating temperatures at the bearing.

For high-speed operation, the bearing preload should be kept to a minimum necessary to assure sufficient bearing rigidity. In cases where lower operating speeds are desired, bearing preloads may be increased to obtain additional bearing rigidity, provided the proper operating temperatures are maintained. Thus, a balance between heat generation and spindle rigidity dictates the amount of bearing preload that is used, commensurate with the operational speed and the bearing life required. How bearing preloading affects operating temperatures was discussed and graphically illustrated in MACHINERY's Reference Section for June, 1958.

For work-head spindles, the operating speeds are generally low and the loading conditions heavy. Maximum radial and axial spindle rigidity are required under these loads, making increased bearing preload mandatory.

Permissible Speeds for Various Mountings

In the determination of limiting operational speeds corresponding to the permissible ball-bearing preloads for machine tool spindles, many influencing factors are involved. Among those considered are spindle mass and construction; type of mounting; spindle rigidity and accuracy requirements; spindle loads; service life; type of service, intermittent or continuous; and method of lubrication.

Because of the complexity of this subject, an answer encompassing all of the factors is difficult. Over a period of several years, however, data from actual field applications have been accumulated and compiled. To present this material as concisely as possible, the lubrication-speed guidance chart, shown in Fig. 15, was plotted. These curves may serve as a guide to the determination of the types of lubrication and mounting to be used in machine tool spindle bearings, and the permissible speeds for operating different sizes of these bearings. High-speed spindle bearings of the light and extra-light series are included, and bore sizes are from 8 to 80 millimeters.

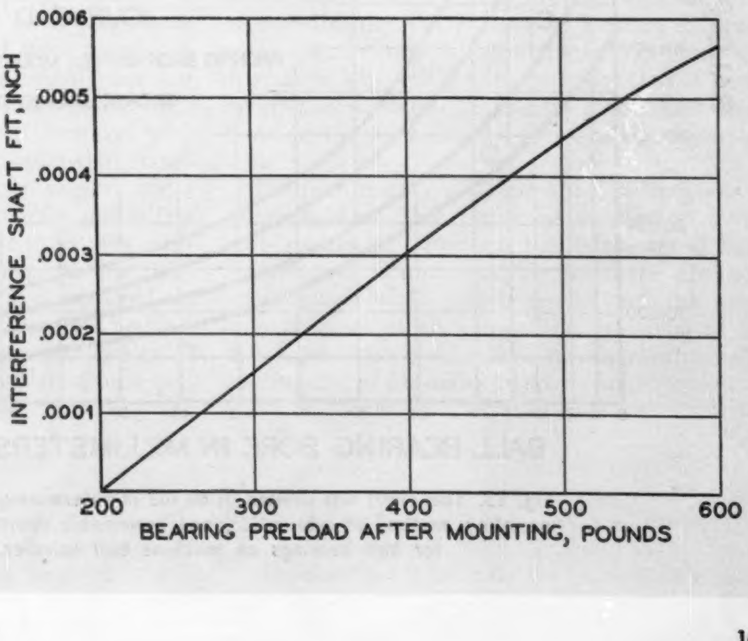


Fig. 14. The effect of shaft fit on bearing preload for extra-light-series, angular-contact bearings having a 90-millimeter bore and mounted back-to-back.

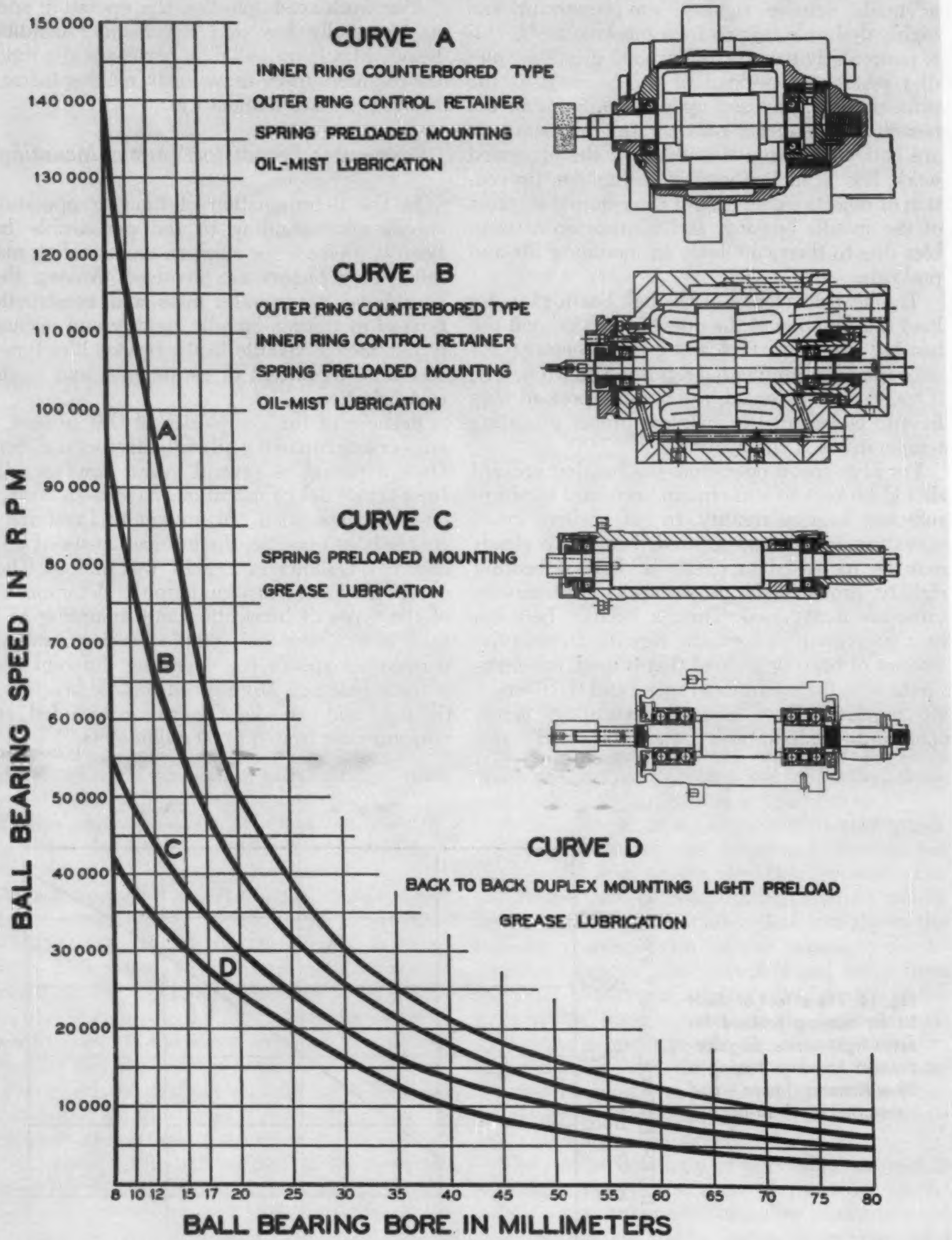


Fig. 15. This chart was devised as an aid in determining the type of mounting, method of lubrication, and permissible operating speeds for ball bearings on machine tool spindles.

Curves *A* and *B* are for exceptionally high speeds where oil-mist lubrication is definitely required. Ball bearings for these applications are spring-preloaded. Such mountings include wheel-head spindles driven by induction motors operated on high-frequency current. Curve *C* is for grease-lubricated, spring-preloaded ball bearings, generally mounted singly. In these applications, the grease is sealed in for the life of the bearing as in the case of belt-driven, high-speed spindles for internal precision grinding. Curve *D* is for grease-lubricated universal duplex mountings with ball bearings having a light, built-in preload. These bearings are generally mounted in pairs, back-to-back, with or without inner- and outer-ring spacers.

Bearings for Extremely High Speeds

The conventional type of angular-contact ball bearing employed for high-speed spindles has one-piece inner-ring land-riding retainers and counterbored outer rings. But certain limitations exist on its use for extremely high speeds. Examination of some bearing parts that had failed revealed the speeds to have been so high that centrifugal force had caused the balls to override the counterbored side of the outer ring.

Although centrifugal force on the balls in bearings is negligible at slow speeds, it increases with the square of the speed and becomes an important factor in the design of bearings for very high speeds. Centrifugal force places a load on the outer ring and serves to decrease the initial contact angle. In the attainment of equilibrium within the bearing, the contact angle is increased.

Bearings having outer rings of the Conrad type construction with symmetrical outer-ring lands have given good performance at these speeds. In addition, maximum ball complements are required to maintain a high degree of rigidity. Both features are incorporated in ball bearings with counterbored inner rings and outer-ring, land-riding retainers. Since the inner ring is open-sided, this construction permits the immediate entry of oil-jet lubrication to the inner-ring raceway and ball load zone, the oil passing radially outward. Thus, the oil is effectively utilized for lubrication and for dissipating generated heat.

Two wheel-heads of the type shown in Fig. 16 employing these bearings were placed on a production line for grinding internal raceways and bores and operated at 100,000 rpm. The bearings were oil-mist-lubricated and the motor casing, water-cooled. Operating temperatures of the wheel-heads directly over the bearings did not exceed 100 degrees F. and no bearing failures were encountered in more than 3000 hours of operation. At 100,000 rpm, the inner ring of each bearing completed 18 billion revolutions and traveled 550,000 miles at a speed of 180 miles per hour.

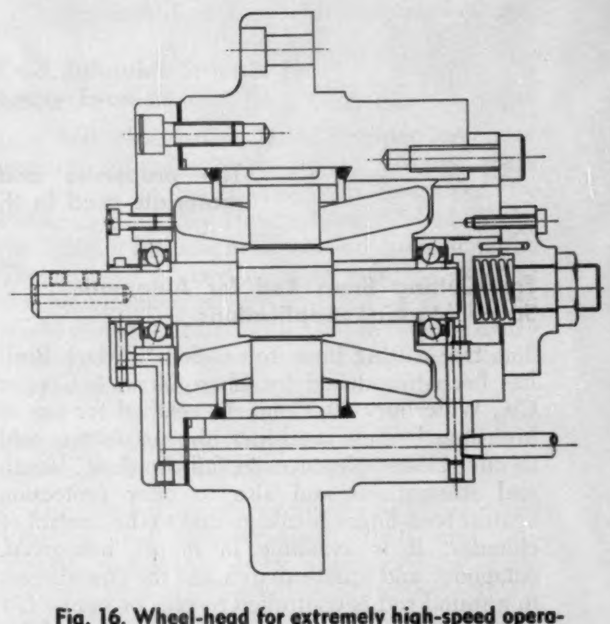


Fig. 16. Wheel-head for extremely high-speed operation. The bearings used have symmetrical outer rings, counterbored inner rings, and outer-ring land-riding retainers. This construction permits easy lubrication and prevents bearing failure due to the high centrifugal forces encountered.

The performance of these wheel-heads poses a question. Can 3000 hours be considered good ball-bearing life? Perhaps this is answered best by making a comparison. To equal the distance represented by 18 billion revolutions, the rear-axle bearings of an automobile, traveling at 50 miles per hour, would have to run continuously night and day for about twenty years.

MATERIALS

The properties and new applications of materials used in the mechanical industries

Free-Cutting Brass Rod for Automatic Screw Machine Applications

A free-cutting brass rod called "3 Mark Rod" has been introduced by Chase Brass & Copper Co., Waterbury 20, Conn. Developed for use in high-speed screw machines, the product is said to offer closer tolerances in "off-the-shelf" length and straightness and also to offer protection against feed-finger breakage due to the control of chamfer. It is available in round, hexagonal, octagonal, and square shapes and the straightness in a round rod is controlled to plus or minus 1/4 inch in a 10-foot length. In other shapes, straightness is controlled to 3/8 inch in a 10-foot length.

High-Strength Aluminum Casting Alloy that is Heat-Treatable

A high-purity aluminum alloy called "MA-356," which can be used to make sand and permanent-mold castings for missiles and high-performance aircraft, has been developed by Rolle Mfg. Co., 3rd and Cannon Aves., Lansdale, Pa. A variant of the conventional A-356 alloy, this material is highly responsive to heat-treatment. In the T-6 condition the ultimate strength ranges from 40,000 to 50,000 psi and the yield strength from 30,000 to 40,000 psi. The elongation is from 2 to 5 per cent. This alloy regularly exceeds the physical properties specified in MIL-C-21180A.

Adhesive and Sealer for Metals and Non-Metals

An adhesive and sealer that can be used to repair virtually everything from a broken chair leg to a cracked engine block has been announced by Cycleweld Chemical Products Division, Chrysler Corporation, Detroit 31, Mich. Called "Cycleweld Liquid Iron," it is a putty-like synthetic plastic that sets into a substance like iron a few hours after it is mixed with a clear liquid hardener. After hardening, it can be ground, sanded, shaped, filed, or drilled. It dries in air without heat or pressure and will bond iron, bronze, wood, aluminum, brass, porcelain, marble, glass, and other materials. The product is durable, nonshrinking, and nonexpanding during drying, and will withstand the corrosive effects of mild acids and alkalis. It may be painted with any type of paint.

Coolant that Arrests Saw-Blade Wear and Promotes Clean Edges

A cutting coolant called "Keystone 106," that is used in the ratio of 10 parts of water to 1 part of coolant, is being produced by Keystone Lubricating Co., 3100 North 21st St., Philadelphia, Pa. It is a high-detergency, water-soluble coolant which contains no oils and forms a true chemical solution. The coolant is rust-inhibiting. It is odorless, smokeless, nonflammable, harmless to the skin, and unaffected by either extreme heat or freezing.

Water-in-Oil Fire-Resistant Hydraulic Fluid Offered

A water-in-oil, emulsion type hydraulic fluid with fire-resistant properties, a viscosity index of 130, and a good film strength at high temperatures has been offered by Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa. "Sunsafe," as it is called, may be used in any hydraulic system where a fire-resistant type fluid is considered desirable or necessary at pressures up to 2000 psi and operating temperatures up to 150 degrees F.

The fluid may be used with all centrifugal, rotary, and reciprocating or piston type hydraulic pumps incorporating plain or friction type shaft bearings, except where manufacturer's instructions indicate otherwise.

Wear-Resistant Extruded Manganese-Bronze Alloy for Machine Parts

Development of an extruded manganese-bronze alloy for long-wearing application in bushings, gears, cams, shafts, and connecting-rods has been announced by Ampco Metal, Inc., 1745 South 38th St., Milwaukee 46, Wis. The alloy, called "Ampcoloy 666," is extruded from continuous-cast billets. It has good bearing char-

acteristics, good machinability, and high resistance to wear and corrosion. Its wear-resistant characteristic facilitates its use for high-production runs in automatic machines.

Nonflammable, Almost Nontoxic Agent Available for Degreasing

The availability of "No-Tox," a degreasing agent with characteristics similar to carbon tetrachloride, has been introduced by Electro-Chemical Products Corporation, 427 Bloomfield Ave., Montclair, N. J. This product has the same MAC rating as isopropyl alcohol, dries quickly, and is said to be safe. It is also said to be completely nonflammable, and to have low toxicity. The agent can be used in any type of degreasing operation with the exception of vapor-phase degreasing.

Aluminum Sandwich Core Material that Serves Production Tooling

An aluminum sandwich core material with unique "drape" characteristics is being used as a production-tooling material, according to the producer, Narmco Resins & Coatings Co., 600 Victoria St., Costa Mesa, Calif. Called "Multiwave," it was originally designed as a core material for high-strength, lightweight aircraft structures of complex design. Recently, it has been adapted to the construction of a variety of production tools including welding jigs, holding fixtures, and large molds for forming plastic and light-metal parts. Tools are made up of sandwich panels with thin skins of reinforced plastic on both sides of the core material. This material has good formability and may be draped over the most complex molds or shapes, including those with compound curves.

Cold, Dilutable Stripper for Epoxy Enamels

A cold, chlorinated, liquid stripper for epoxy enamels dilutable with up to twenty parts by volume of water has been developed by Enthone, Inc., New Haven, Conn. Called "Stripper S-26," it is acidic in nature and nonflammable. The stripper is used at room temperature and acts by wrinkling and detaching the enamel from the base metal. It has been used to remove epoxy coatings from most metals including steel, aluminum, copper, brass, and zinc die-castings.

Forgeable Sintered Tungsten that May Be Machined Conventionally

The availability of readily forgeable sintered tungsten and tungsten-alloy billets and preformed shapes has been announced by Firth Sterling, Inc., 3113 Forbes St., Pittsburgh 30, Pa. The metals are available in hollow conical and cylindrical shapes up to 8 inches in diameter and 4 inches long, as well as in billets 4 1/2 inches in diameter and 12 inches long. The tungsten-molybdenum alloy contains 50 per cent tungsten and 50 per cent molybdenum. It has a melting point close to 5300 degrees F.

These materials are used for components in jet aircraft frames and engines, missiles and space vehicles, as well as for radiation shielding, counterweights, and gyro rotors.

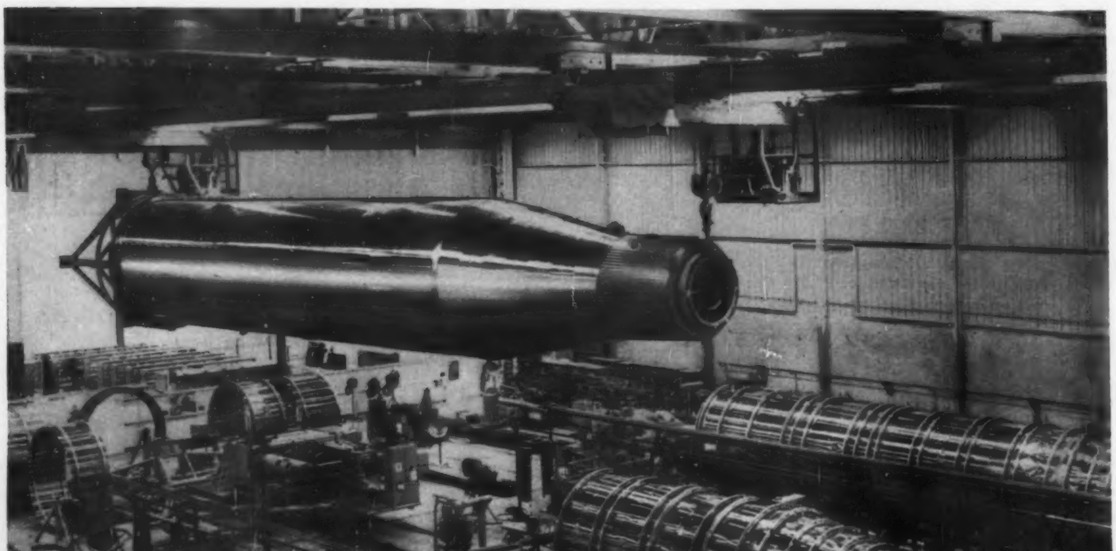
This forged piece made of Firth Sterling's forgeable sintered tungsten has been machined cold with a conventional tungsten-carbide tool. Note the type of chips that have resulted.

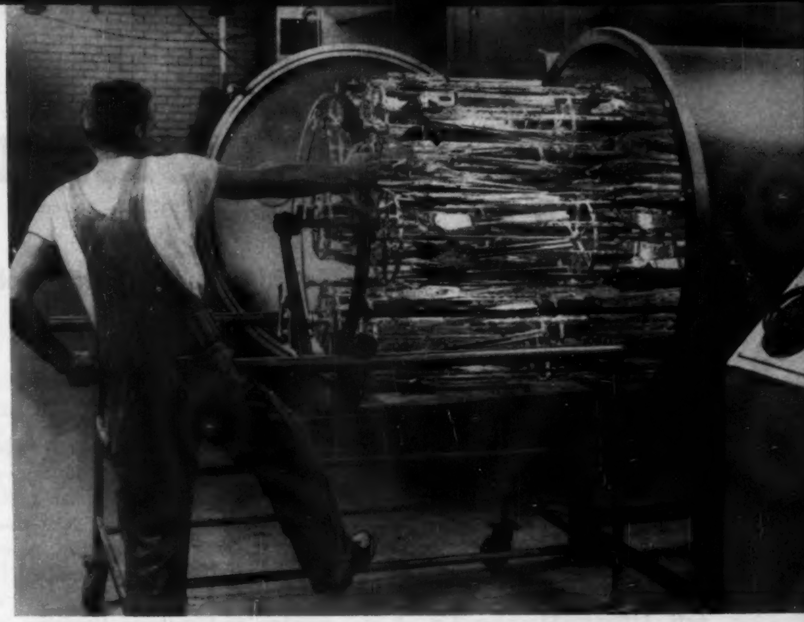
IN SHOPS AROUND THE COUNTRY

Camera highlights of some interesting operations performed in various metalworking plants

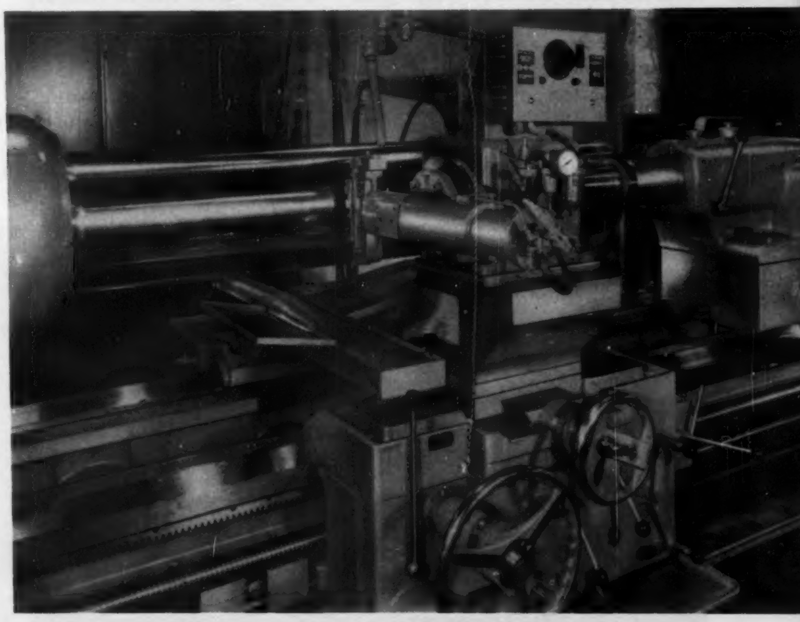
ANNEAL-GO-ROUND—This automatic table at Raytheon Mfg. Co.'s power tube plant in Waltham, Mass., solves a bottleneck in magnetron tube production by speedily annealing glass-to-metal sub-assemblies. After being heated, spun, and sealed on lathe seen in background, the sub-assemblies are loaded on rotating fixtures on the table. Indexing aligns the fixtures with five groups of gas jets. Temperature of first group is 400 degrees C. and falls gradually to 100 degrees C. at the fifth.

MIGHTY ATLAS—A 60-foot tank for an Atlas ICBM moves via cranes to the final assembly area in the plant of Convair's Astronautics Division, San Diego. All supports have been removed from the skin-thin tank, and it has been pressurized to hold its shape. The tanks being assembled below it still have supporting rings around them. The tank will be mated to the propulsion section, and the control, guidance, telemetry, power supply, tracking, and other systems will be added.





JUNIOR ARTILLERY—At Nichols Industries, Inc., Jacksonville, Tex., toy gun barrels of die-cast zinc are now finished by vacuum metallizing in Stokes plating equipment. Parts are first lacquered, then go on revolving spiders on a metallizing reel and are rolled into a chamber. When proper vacuum has been reached, molten aluminum wire heated by tungsten filaments hanging in the chamber is vaporized, coating all exposed surfaces. The vacuum is then broken, the door opened, and the work is ready to be removed.



4-MICRO-INCH FINISH—Grinding marks are removed from a column sleeve for a Hole Wizard radial drill by superfinishing, at the American Tool Works Co., Cincinnati. The operation is performed on a Pacemaker lathe equipped with a Gisholt attachment. With the sleeve revolving slowly, the attachment oscillates superfinishing stones laterally. In four to six hours, a ground finish of 16 to 32 micro-inches is reduced to 4 to 8 micro-inches.

PROJECT MERCURY—The American Welding & Mfg. Co., Warren, Ohio, believes these titanium rings it is fabricating are the largest ever to be made of the metal. The rings, 74.050 inches in diameter and 2.875 inches thick, are for the NASA's Project Mercury, America's program for sending its first man into orbit around the earth. The huge rings are held to a tolerance of plus or minus 0.010 inch during roughing operations.

LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts, and

Cincinnati "Grind-A-Mate" Gaging System

Missile control valves, fuel injector plungers, and similar shaft-like work-pieces are ground to fit mating parts within millionths of an inch on equipment embodying a "Grind-A-Mate" gaging system. The machine, built by the Cincinnati Milling Machine Co., Cincinnati, Ohio, a 4-inch precision grinder, can also be used to advantage for one-of-a-kind parts such as master gages. All elements are under complete control in an automatic cycle, so that accurate work is consistently produced.

Tolerances are held within 0.000010 inch for roundness, 0.000020 inch for straightness, and 0.000025 inch for size. A surface finish of 4 micro-inches is obtained. The gaging system, developed by Cincinnati engineers, consists of inside- and outside-diameter air units and a high-amplification differential meter. The outside-diameter unit, an integral caliper, does not touch the work, thus eliminating any chance of chatter or taper.

In operation, the air units are set from masters. Clearance is "dialed in." The part to be matched is placed on the inside-diameter gage and the work-piece is positioned between the centers. After the outside-diameter gage is swung into position, the cycle start button is pressed and the operation proceeds automatically. Cycle time for average stock removal of 0.0003 to 0.0008 inch is approximately one minute. To grind without mating, the inside-diameter gage is simply inactivated. If matched grinding is not likely to be required, the

Fig. 1. Machine and gaging system for matched-hole grinding to millionths of an inch

IN SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by Freeman C. Duston

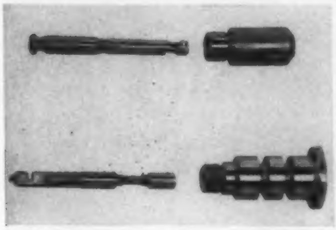


Fig. 2. These two plungers, shown with their respective valves, represent the type of work for which the gaging system was designed

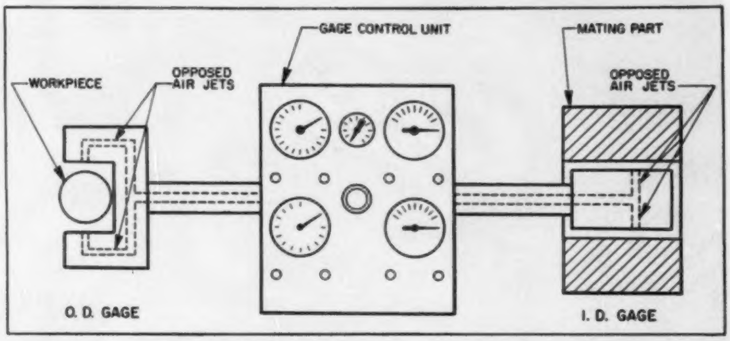


Fig. 3 Diagram showing control between mating parts and work-piece

gaging system can be provided with an outside-diameter gage only.

To obtain precision measured in millionths, the machine is extremely rigid, and is fitted to alignment specifications about five times as stringent as those for a standard grinder. Weight has been increased substantially; for example, minimum wall thickness in the base casting is 3/4 inch. Hydraulics are isolated, all motors are super-dynamically balanced, and special attention is given to transmission of power in order to eliminate vibration. Taper is controlled by a "Gage-Line," an electronic device which continuously checks alignment of the centers.

The completely automatic control of all functions during the cycle assures that the ultra-close tolerances are held. Control of the infeed illustrates this. When the cycle begins, a normal infeed rate is used to remove stock. At a given point in the process, the rate is reduced for final sizing. This point is set on the control gage and is recognized by a pressure switch which reads the changing resistance in the air caliper. A second pressure switch is actuated when final size is reached, retracting the wheel-head.

In order to preserve roundness of the work to a high degree of accuracy, infeed of the wheel-head must be maintained at a smooth and continuous rate. This is necessary to assure a uniform feed per revolution, proper speed ratio between wheel-head and work, and control over stick-slip or friction.

Thermal conditions are also carefully controlled. For example, coolant temperature is regulated by a differential thermostat to 2 degrees above room temperature. By the time it reaches the work, evaporation has cooled it to work-piece temperature. Variable-delivery hydraulic pumps are used to minimize blowoff through relief valves, thus maintaining the ambient temperature of the oil at a relatively low level.

Circle Item 565 on postcard, page 195

Fig. 4. Caliper, shown in swung-out position, never touches the work surface

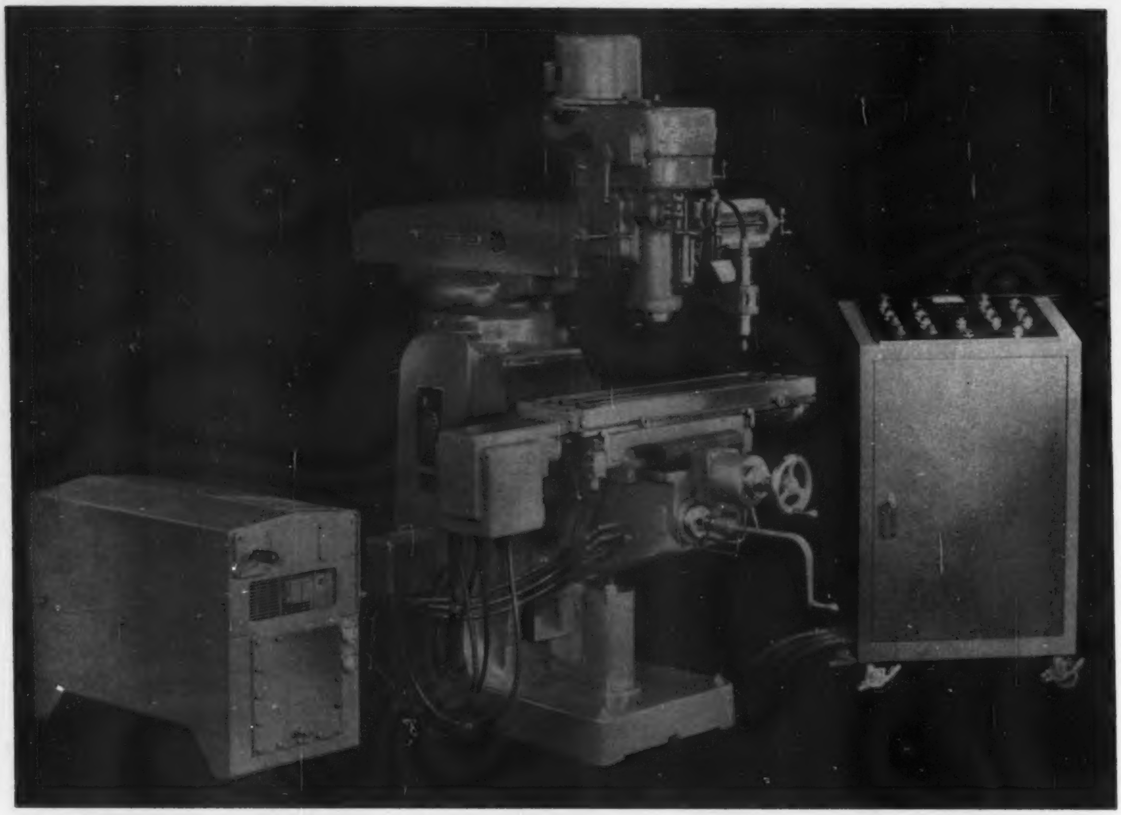


Fig. 1. Gorton 1-22 Mastermil equipped with 180-degree Auto-Trace electrohydraulic system

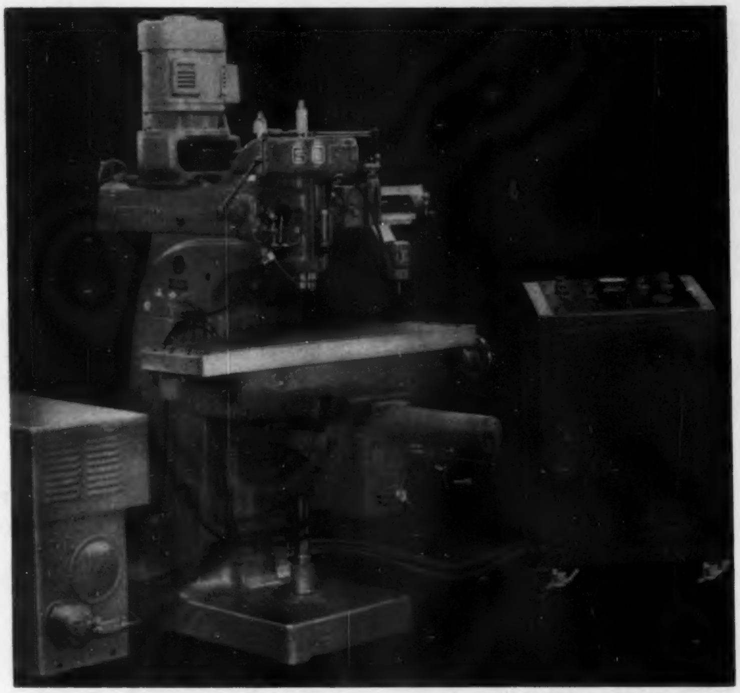
Gorton "Auto-Trace" Automatic Milling Machines

Two automatic milling machines of the tracer-controlled type, featuring a combination of electronic tracing and hydraulic-power feeds, have been announced by the George Gorton Machine Co., Racine, Wis. Fig. 1 shows the Gorton 1-22 Mastermil equipped with 180-degree "Auto-Trace" electrohydraulic duplicator specially designed for accurate, three-dimension scanning. The Gorton 9-J vertical mill, equipped with 360-degree Auto-Trace electrohydraulic system, is shown in Fig. 3. This machine is especially adapted for fast, accurate profiling by automatic tracing.

The Mastermil, Fig. 1, is an automated unit incorporating many features designed for milling convex and concave shapes at higher feed rates and to closer tolerances than was previously possible. This equipment can also be operated as a conventional power or hand-feed milling machine, utilizing the full length of table and saddle feed-screws. With electrohydraulic tracing the machine is not "paced" by the operator and accuracy is not subject to human error. Thus, rejects and scrap are eliminated and hand-finishing time is cut to a

Fig. 2. Machine shown in Fig. 1 set up to reproduce part of piston mold from a finished mold

Fig. 3. Gorton 9-J vertical mill equipped with 360-degree Auto-Trace electrohydraulic system



minimum. Little attention is required of the operator, only occasional cutter inspection being necessary. With increment cross-feed, this machine also does three-dimensional jobs automatically.

The Auto-Trace electrohydraulic system of the unit is standardized as to tracer, control console, and hydraulic pump and tank. However, the application of this system to various Gorton milling machines may differ, due to customer requirements and the individual design features of each machine.

The Gorton 1-22 Mastermil, Fig. 1; the 9-J vertical mill; the 2-28, 3-34, and 3-48 gear-driven vertical mills; and the Gorton double-column bedmill can all be factory-equipped with the Gorton Auto-Trace electrohydraulic 180-degree duplicating system. Special machine applications are also available through the company's special machine division.

The close-up view, Fig. 2, shows a typical setup on the machine illustrated in Fig. 1. Here, the 180-degree Auto-Trace electrohydraulic system is employed to reproduce automatically, in three dimensions, part of a piston mold from a finished mold.

The minimum center-to-center distance between tracer and cutter spindles of the Mastermil, Fig. 1, is 12 1/2 inches, and the maximum distance, 25 3/4 inches. Vertical adjustment is 10 inches and cross adjustment, 5 1/2 inches. Distance from tracer-spindle nose to table top ranges from 0 to 16 7/8 inches. Longitudinal table feed hydraulically or by feed-screw is 21 1/2 inches and cross table feed, 9 1/2

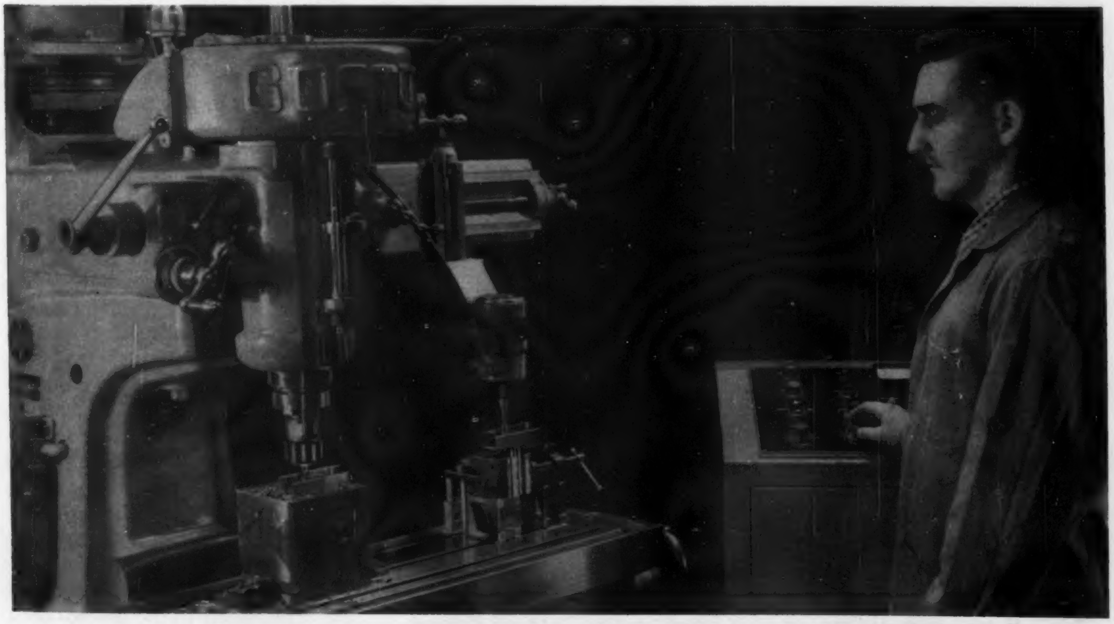


Fig. 4. Vertical mill, Fig. 3, equipped to automatically profile a printing-press shifter fork

inches. Hydraulic feed of 4 inches plus screw feed of 12 inches gives the knee a total vertical feed of 16 inches.

This Mastermil is 80 inches in height and requires a floor space 88 inches wide by 77 3/4 inches deep. The console is 28 1/2 inches wide by 24 inches deep by 48 1/2 inches high. Tank and pump unit is 26 inches high, 23 inches wide, and 40 3/4 inches deep. The machine weighs 3400 pounds.

The 9-J vertical mill, Fig. 3, is equipped with the 360-degree Auto-Trace electrohydraulic system. This automatic profiler is designed to increase productivity, lower costs, provide better finishes, and hold work to closer tolerances. Tracing and cutting are completely automatic. The automatic profiler operates in all lateral directions (360 degrees) and can also be furnished at additional cost with automatic, vertical increment feed. While in operation, it requires only occasional cutter inspection.

An outstanding feature is that the electronic tracer control has been combined with hydraulic feeds. The result is claimed to give a new standard of accuracy due to the instantaneous reaction of the sensitive electronic tracer and the smoothness of hydraulic power.

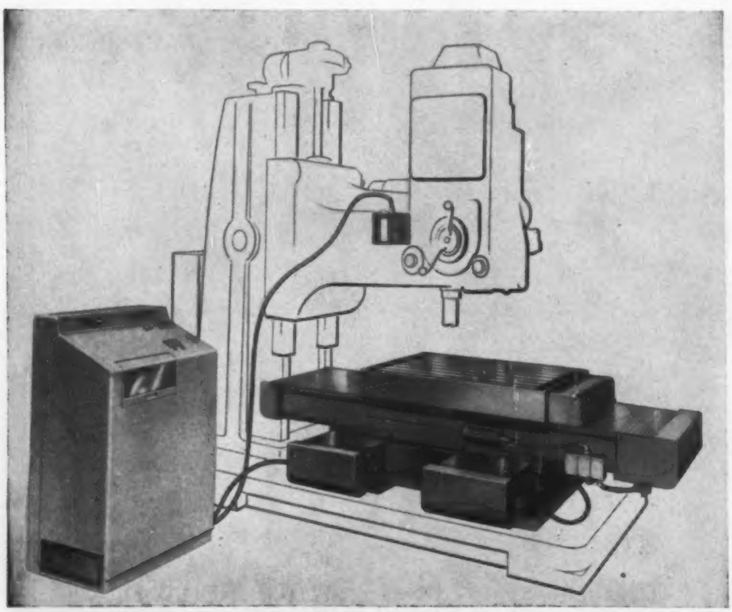
Repetitive accuracy (one piece or a production run—part to master or part to part) to closer limits is said to be possible on this machine. The human element of error is entirely eliminated once the setup is completed and the machine takes over. The tracing system is specially adapted for profiling inside or outside contours of simple or complex shapes. This includes machining extruding dies, punch and die sets—both male and female—and cutting propeller and impeller blades. It can be used for profiling multiple sections—male or female—from a single section master; is excellent for sizing flame-cut or flat-forged parts, and for profiling deep openings or ports by employing the special increment vertical feed. With multiple cutter spindles, more than one piece can be produced from a single master.

Fig. 4 shows a typical setup of this machine. The work consists of automatically profiling a printing-press shifter fork. This vertical mill, Fig. 3, is somewhat larger and heavier than the one shown in Fig. 1, and has a slightly larger work-handling capacity.

Circle Item 566 on postcard, page 195

Fast-Spacing Table for Precision Drilling Machines, Controlled by Tape System

A two-axis, tape-controlled positioning table, said to be the largest and fastest available for precision drilling machines, is a product of the Cincinnati Bickford Division of Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. It is operated by a numerical-control system developed specifically for it by Concord Controls, Inc., Boston, Mass., and Cincinnati Bickford. The table measures 38 by 50 inches and has a travel range of 32 by 44 inches; load capacity of 10,000 pounds; and a rapid-traverse positioning speed of 360 inches per minute. The control is operated by standard, punched paper tapes.



Two-axis, tape-controlled spacing table brought out by Cincinnati Bickford Division of Giddings & Lewis Machine Tool Co.

The numerical positioning system, operated by either punched tape (choice of several sizes) or a manual keyboard, is designed to position up to 5 tons of work for drilling, reaming, boring, tapping, or layout at speeds of 360 inches per minute at accuracies to within 0.001 inch and with repetitive accuracy to within 0.0005 inch.

Instructions can be punched into 7/8- or 1-inch tape on a standard tape-preparation unit. Five-channel tape can also be employed. The system works on a decimal system, eliminating complicated conversion tables. If work prints call for holes or locations not provided for on the punched tape, the operator can assume control of the table and insert additional instructions from a keyboard on the console.

The table operates in all four work quadrants, accepting either plus or minus commands in the X or Y axis or in both these axes. In the latter case, traversing (at a speed of 360 inches per minute) and final positioning (at a speed of 20 inches per minute) take place in both axes simultaneously.

Tape can be prepared at any time prior to release of the production order to the shop. Once used, it can be stored until it is needed again, then removed and placed on the tape reader in the control console. If additional positions are re-

quired, or a block of information must be removed, the tape can be cut and spliced by using ordinary scissors and mucilage.

To produce a part, the machine operator first clamps the work to the table in the usual manner. He then inserts the tape in the transport at the front of the console, snaps the mode or cycle switch to the "manual" position, and turns on the power. In this "manual" mode, the operator sets the control circuits to the setup position by means of push-buttons. Next, he changes the switch to "setup" mode and brings the table to that same position. Rotating the switch to its third position, marked "tape," serves to lock the table and circuits. The operator then presses the start button and follows his manuscript as the tape automatically assumes control and guides the table in the complete machining cycle.

An exact numerical read-out is given to the operator by indicators located on the console. This visual measuring system enables the operator to verify each position as it is reached, thus introducing quality control on the job. Additions to, or changes in, the program are easily handled: the operator merely switches to the "manual" mode at the desired point in his manuscript and punches the appropriate push-buttons on the ten-digit console keyboard. As soon as he switches back to "tape" and presses the start button, automatic operation resumes.

Circle Item 567 on postcard, page 195

Sundstrand Multiple-Cycle Tracer Lathe

A 25-hp, multiple-cycle, hydraulic tracer lathe that permits three roughing cuts and a finish-turning cut to be made from the same template is announced by Sundstrand Machine Tool, Division of Sundstrand Corporation, Belvidere, Ill. The closely coupled stylus and cutting tool of this lathe are designed to reduce the possibility of deflection and thus insure a high degree of accuracy.

To simplify setup and insure maximum accuracy, graduated scales are provided for dog setting, template positioning, tailstock positioning, and location of the cross-facing slide. Dial indicators at the top of the tracing carriage permit accurate depth setting of the first three cuts. After the three roughing cuts are taken, the tool turret indexes for the finishing cycle with a 0.020-inch depth of cut. This arrangement makes it practical to use carbides for the first three cuts and finish the job with ceramic tools, if desired. The machine is designed for maximum utilization of ceramic tooling.

Model 14T-25 has a transmission type head which provides an automatic speed change for the finishing cut. Two- or four-speed heads are available on standard models.

Spindle speeds from 340 to 3100 rpm are available with the two-speed head. The four-speed head has a range of from 225 to 3100 rpm. Pick-off gears are used to select the required speed. Feed is infinitely variable within a range of 4 to 50 inches per minute. Rapid traverse rate is 230 inches per minute.

A facing slide with a separate feed unit is available as an optional extra. It can operate at any time during the machine cycle, depending upon the requirements of the part being produced. Tool relief to the facing slide can also be added. Loading of work is simplified because the center line of the spindle is within easy reach of the operator. Also, the open loading area makes it easy to apply automatic handling equipment. The large, open, chip cavity provided in the machine base not only enables easy chip cleanout but simplifies the installation of automatic chip disposal units without requiring modification in the machine base.

Maximum length between centers on the Sundstrand Model 14T-25 is either 24, 32, or 40 inches. Maximum turning diameter is 4 1/2 inches while minimum diameter of finish-turned parts is 1/2 inch. Facing slides with a maximum stroke of 3 1/2 inches and a rapid feed rate of 36 inches per minute can be provided.

This tracer lathe makes it possible to turn or reverse the parts quickly to permit machining both ends. Quick and accurate positioning of dogs and template reduces the down time required for change-over and permits the machine to be applied economically on short runs. The machine is being introduced as companion equipment to the Sundstrand Model 14T-40 lathe, which has a 40-hp motor and is designed to handle larger work.

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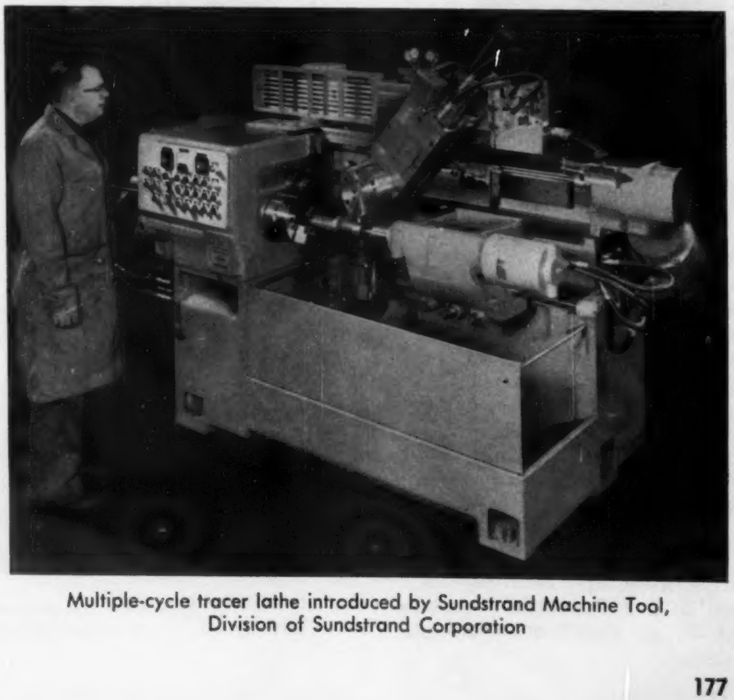

Multiple-cycle tracer lathe introduced by Sundstrand Machine Tool, Division of Sundstrand Corporation

Pratt & Whitney Measuring Machine

Pratt & Whitney Co., Inc., West Hartford, Conn., has announced the development of a numerically controlled gaging machine designed to check components of practically any shape at any desired number of coordinate points of their inner or outer surfaces. For example, complex missile shapes can be checked quickly and accurately with this machine even though hundreds of individual reference points may be involved. Thus, the measuring unit serves to eliminate inspection bottlenecks and reduce gaging costs.

Known as the "Data-Limit" 6 coordinate measuring machine, this instrument has two gaging arms. Each arm is capable of movement in the X, Z, and Theta coordinates—horizontal and vertical movement plus rotary motion around the X and Z coordinates. Operation is fully automatic. Input data carried on an easily prepared perforated tape is used to move the gaging arm and head to a reference point on the work-piece—and then to position the gage head at a desired series of points in space. At each point the gage head measures the deviation of the work-piece surface from its nominal location. The measuring machine is also equipped with digital readout, which makes it possible to store, record, or mathematically process the gage data in almost any desired manner.

The use of a perforated tape eliminates the time and expense of preparing templates and other special gage tooling. As a result, part-to-part change-over is said to be fast, simple, and economical. Engineering changes can readily be incorporated at any time without causing inspection bottlenecks.

The Data-Limit 6 coordinate measuring machine has been designed and constructed throughout for a high degree of accuracy. Ways, which are hardened, ground, and lapped to a 2- to 3-micro-inch finish, ride on rolls ground to an accuracy of 0.000010 inch. Over-all gaging accuracy is said to be 0.000150 inch with a repeatability accuracy of 0.000050 inch.

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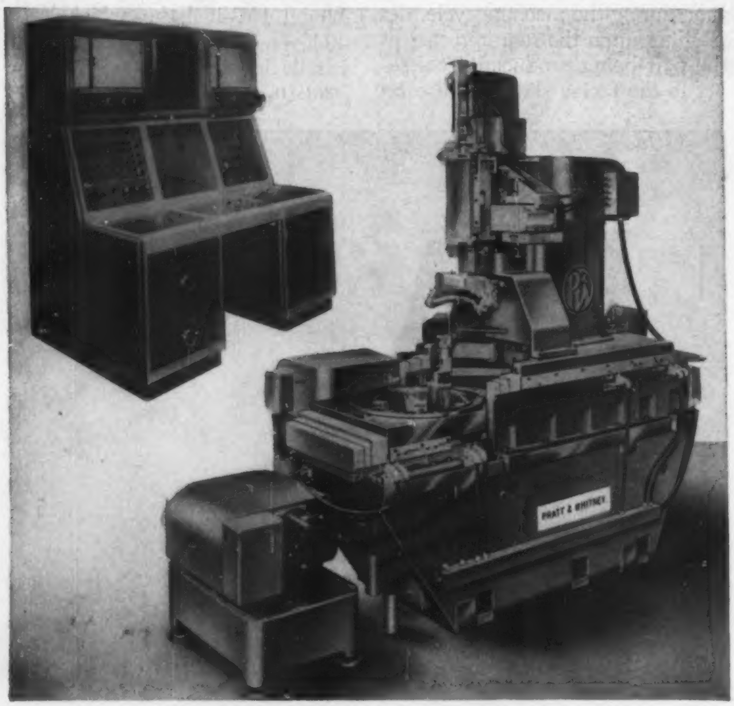


"Data-Limit" numerically controlled measuring machine announced by the Pratt & Whitney Co.

Precisionaire gages made by Sheffield Corporation

Long-Range Air Gage

A column type, dimensional-inspection air gage with 15 inches of gaging range is announced by the Sheffield Corporation, Dayton, Ohio, a subsidiary of Bendix Aviation Corporation. The gaging range of this instrument is two to three times greater than that of most gages now used by industry. Designated the Model 1500 series, long-range Precisionaire, the gage (shown at the lower right in the illustration) has a full 15-inch linear column and scale with amplifications up to 100,000 to 1. It was developed to meet the increasing need of precision manufacturers for gaging broader dimensional tolerances at higher amplification. In the upper left corner of the illustration is shown a Sheffield dial type Precisionaire gage designated the "Little Champ." The column type instrument shown at the lower left is representative of gages now being used in large numbers for dimensional control and precision inspection.

Standard Precisionaire gaging elements such as spindles, snaps, Plunjet gaging cartridges, and open-jet tooling which are balanced for part tolerance can be used with the longer-range instrument. Existing Precisionaire tooling can also be used.

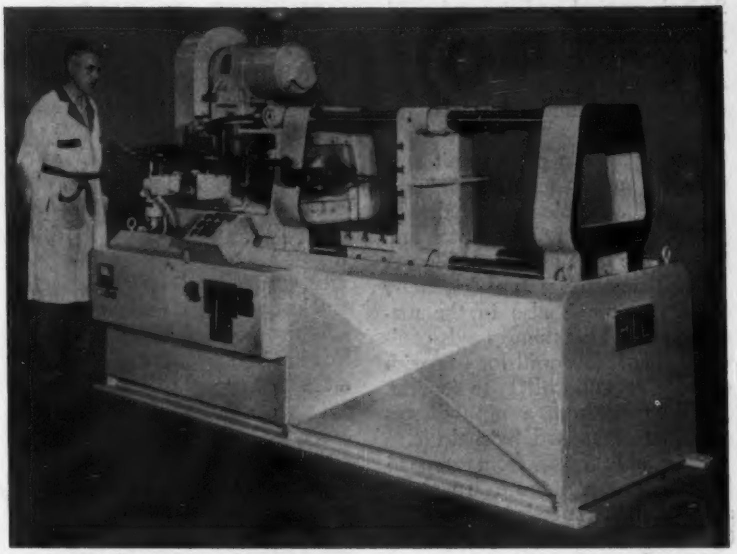
Circle Item 570 on postcard, page 195

Giant-Size Mechanical Press

A giant-size, 1000-ton mechanical press, believed to be the largest in the electrical-distribution and control equipment industry, has been built by the Verson Allsteel Press Co., Chicago, Ill., and is being installed at Federal Pacific Electric Co.'s Thornton St. plant in Newark, N. J. This press is designed to perform simultaneously a complete series of metalworking operations. It will be used for turning out relatively small (24-inch-long) metal enclosures especially designed for Federal Pacific's new line of stab-in service equipment.

The huge press takes raw coil steel, and by means of massive six- and seven-stage progressive dies (weighing 5 tons each), stamps out enclosures at the rate of twenty per minute. The complete press weighs 265,000 pounds and is housed in a concrete foundation 13 feet deep. It is designed and tooled to produce two types of enclosures from the same die.

Circle Item 571 on postcard, page 195



Hill-Drill high-speed drilling machine designed for deep-hole drilling, gun-drilling, gun-reaming, or precision boring operations

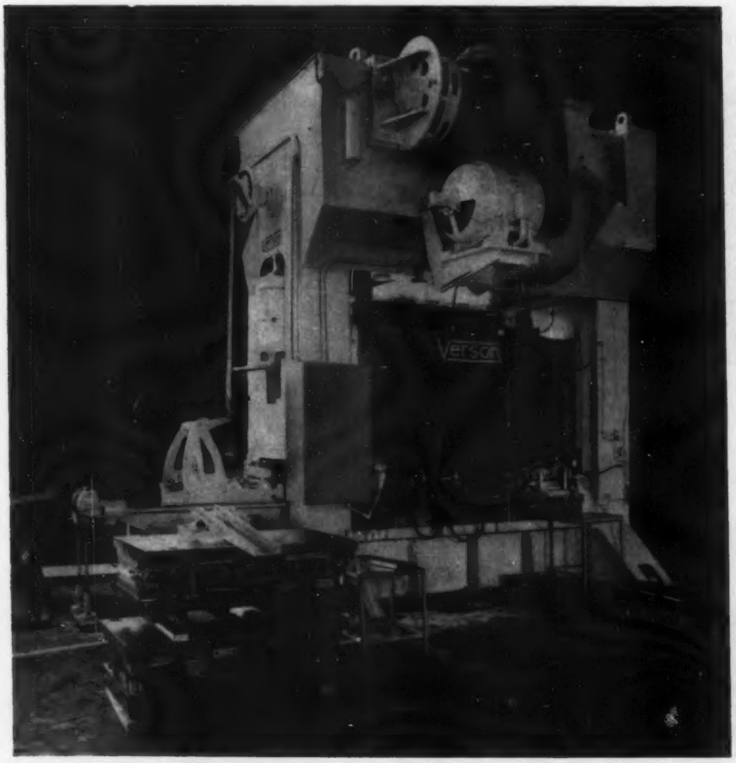
Versatile High-Speed Drilling Machines

High-speed, single-spindle, horizontal drilling machines, called "Hill-Drills," that will perform deep-hole drilling, gun-drilling, gun-reaming, and precision boring operations, are announced by Walter P. Hill, Inc., Detroit, Mich. Single- and multiple-flute carbide gun drills; carbide gun reamers; standard high-speed steel twist drills; oil-flute twist drills; and insert-tool boring-bars can be effectively applied on these machines. Standard twist drills can be fed into steel at exceptionally fast rates while maintaining size accuracy and tool life. For example, the suggested feed rates for a 1/2-inch-diameter standard twist drill in steel range from 40 to 80 inches per minute.

The spindle, driven by a 10-hp motor through V-belts and a multiple-speed drive, is in the form of a 4-inch-diameter hollow quill that travels in a honed Meehanite sleeve. Two 3 1/4-inch-diameter hydraulic cylinders advance the quill. They can develop up to a 16,000-pound thrust for feeding the drill into the work.

The drill head, universal fixture mounting table, and the four 3-inch-diameter guide bars on which the table slides are of unit construction supported by the welded steel base of the machine.

The universal type work-fixture mounting table has longitudinal and transverse T-slots, an 18- by



Verson Allsteel 1000-ton press installed in Newark, N. J, plant of Federal Pacific Electric Co.

24-inch vertical surface, and a 12- by 18-inch horizontal surface. This table can be equipped with a numerical positioning system to eliminate jigs and fixtures if desired.

The hydraulic power unit consists of a 10-gallon-per-minute, 1000-psi, variable-flow hydraulic pump, and a 7 1/2-hp motor and tank in the base of the machine. A 1000-psi coolant pump driven by a 5-hp motor is also in the machine base. This pump feeds coolant through the quill for use with oil-hole or gun-drill type tooling. Nozzle flow from a pipe directs coolant to standard twist drills.

Adjustable feeds from zero to 150 inches per minute are available. Spindle speeds range from 600 to 4000 rpm. Total head travel is 12 inches. The table has a total linear adjustment of 4 feet. Part capacity is 18 by 24 inches by 3 feet long. The machine illustrated occupies a floor space about 9 feet long by 3 feet deep and has a height of 45 inches from the floor to the center of the quill.

Circle Item 572 on postcard, page 195

Minster Inclinable Press

A 75-ton, single-geared, open-back inclinable press featuring an optional recirculating lubrication system is being introduced by the Minster Machine Co., Minster, Ohio. The Minster recirculating lubrication system used on this equipment continuously lubricates the main and connection bearings, gibs, gears, and counterbalances. Enclosed within the press frame and protected from damage, the lubrication system is said to lower maintenance costs.

Other improved features of this Series I, No. 75 o.b.i. press are a standard modified flanged slide which gives larger die area and an exclusive lower connection ball-box adjustment. The No. 75 is furnished in either flywheel or gear type. The Minster-patented combination air friction clutch and brake unit provides torque overload control, greater tripping efficiency, and controlled cycling and inching. The one-piece, high-tensile-strength alloy, cast-construction press frame has a boxed top to assure rigidity and high compressive strength. The press is inclined manually by a double-screw arrangement.

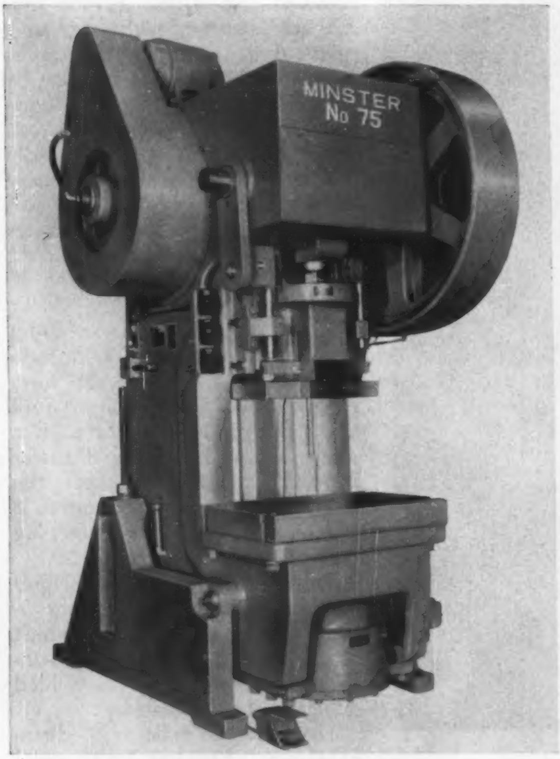
Circle Item 573 on postcard, page 195

Covel Surface Grinder

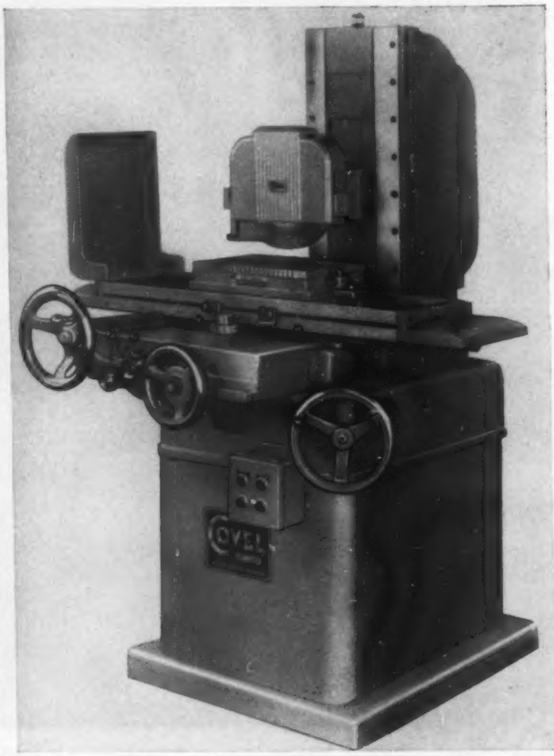
The Covel Mfg. Co., Benton Harbor, Mich., has announced an addition to its line of precision surface grinders. This No. 17H, 10- by 16-inch hydraulic surface grinder has a capacity of 14 inches under a full 12-inch diameter grinding wheel. Infinitely variable table speeds are available up to 70 feet per minute.

Cross-feeds range from 0.005 to 0.250 inch. Rapid traverse is provided for dressing the wheel from the chuck or for quick positioning of the work. The grinder has a 2-hp motor that operates at a speed of 1750 rpm with direct drive to the spindle. The precision ball bearings of the spindle are grease-lubricated and sealed for their normal life.

Circle Item 574 on postcard, page 195



Minster open-back press with improved lubrication system



Hydraulic surface grinder announced by Covel Mfg. Co.

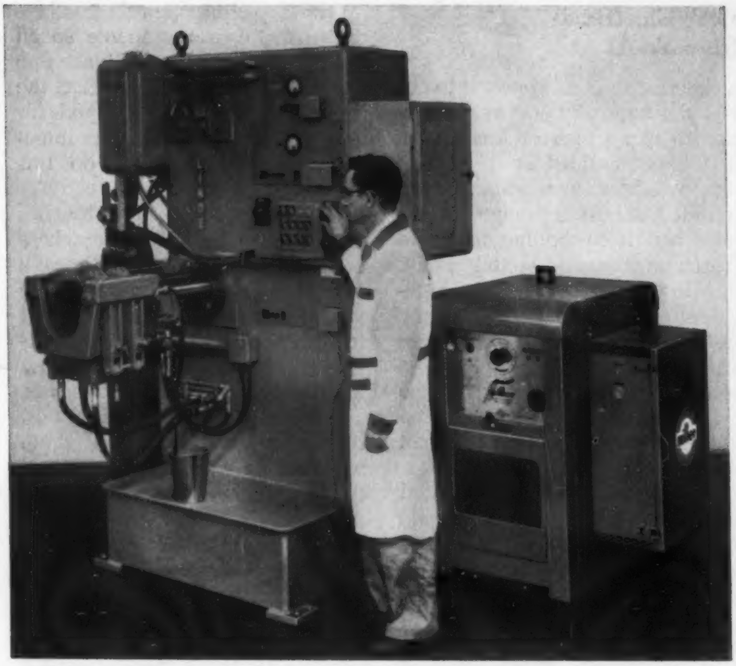


Fig. 1. Automatic longitudinal seam welder equipped to weld coffee-maker bodies announced by Expert Welding Machine Co.

Automated Precision Welding Machines for Longitudinal Seam or Rotary Circumferential Welding

A series of automatic Heliarc welding machines designed for precision welding of longitudinal and circumferential seams has been introduced to the metalworking industry. These machines are based on concepts and general specifications of the Linde Co., Division of Union Carbide Corporation, New York City, and have been designed and built by the Expert Welding Machine Co., Detroit, Mich.

The high degree of accuracy obtained in the manufacture of these machines, coupled with precise electronic arc-length-control welding heads, has made possible the production of 2000 coffee-maker bodies per day with a reject rate of less than 1 per cent. The use of these precision welding machines in the manufacture of coffee-maker bodies is said to have reduced costs below that of deep-drawn assemblies.

One machine, called the longitudinal seam welder, Fig. 1, automatically welds the side seam of the 0.028-inch-thick, stainless-steel coffee-maker body stamping. Another machine, called the circumferential welder, Fig. 2, automatically welds the circular bottom plate in place. The high-quality welds produced by the Heliarc welding process have reduced or eliminated the need for metal finishing on this assembly. The machine shown in Fig. 1 can be adapted for any type of longitudinal seam welding on sheet-metal parts of any shape. The welder illustrated in Fig. 2 can be adapted to practically any type of rotary circumferential welding operations.

Circle Item 575 on postcard, page 195

Kennametal End Mills

Kennametal Inc., Latrobe, Pa., has added a complete line of end mills to its several lines of metal-working carbide cutting tools. These tools are of solid carbide, precision ground in many styles and sizes to meet a broad range of requirements. They are stocked in fifteen styles with diameters ranging from 1/16 to 3/4 inch. Included are end mills having two, three, and four flutes with right- and left-hand spirals and straight flutes. They are made with square and ball nose ends, and with shanks to meet all requirements. The extreme rigidity provided by the one-piece carbide construction of these tools is said to give smooth, even finishes and long tool life.

Circle Item 576 on postcard, page 195

Fig. 2. Circumferential welder which press-assembles the bottom plate to coffee-maker body and automatically welds the assembled parts

Cincinnati "Elektrojet" Electrical-Discharge Machine Tools

The Cincinnati Milling Machine Co., Cincinnati, Ohio, has just announced an "Elektrojet" line of electrical-discharge machine tools. This new line includes thirty-three tools or units of the building-block type, all designed for electrical discharge (electro-spark) machining. The tools are alike in many respects, being built up from only sixteen basic units—two bases, two slides, four work-heads, four base-tank units, and four power-supply units. Many of these building blocks or units are completely interchangeable and have been designed specifically for the specialized requirements of machining by electric sparks.

All Elektrojet machines, like the ones illustrated in Figs. 1, 2, and 3, use actual electric sparks to do the "cutting." Each spark constitutes an individual machining operation in itself. A surface machined by the electric sparks often appears grainy. If viewed through a microscope, it appears to be covered with tiny craters, a thousandth of an inch or less across, and about a third as deep. The crater edges are smooth and rounded, almost as though the surface had been boiling and had frozen at the mid-boiling point. The craters are caused by high-energy sparks that pepper the surfaces at frequencies of from 10,000 up to 250,000 times a second. Where each spark hits the work, a tiny molten gob of metal is ejected, and some more metal is vaporized.

The sparks are propagated across a gap between an electrode and the work-piece. The gap is only about 0.001 inch across, and it is usually bathed with an insulating fluid (dielectric) which helps to control the spark and wash away the debris ejected from the craters.

One of the critical problems in electrospark machining has been to develop equipment that will remove metal at reasonable speed and at the same time produce fine surfaces. It is claimed that the pulse type circuit developed for the Elektrojet line, although somewhat complicated, will do this exceptionally well.

The electrode never touches the work-piece. But anywhere from 10,000 to 250,000 times a second, sparks flash from it to the work-piece across a gap of about 0.001 inch. Work-piece and electrode are bathed in a dielectric fluid to quickly quench the sparks and wash away the debris. Thus, electrospark machining is done within a tank which can contain the fluid.

The basic Elektrojet line consists of a single base and column on which may be mounted four interchangeable work-heads and four base-tank units of different designs. The non-rotating work-head of the type shown on the machine illustrated in Fig. 2 is used for operations such as die-sinking. For this work, the desired shape is produced by the vertical feed of a formed electrode like that seen at the left in Fig. 4.

Rotating work-heads are used for operations in which a revolving electrode is desirable. Generally, rotation of the electrode as it feeds into the work-piece gives improved machining conditions which result in increased stock-removal rates. On this work-head, the spindle rotation can be stopped and the quill feed alone used for plunge type cuts.

Elektrojet machines can also be equipped with universal work-heads, as shown in Fig. 3. In addition to quill feed and electrode rotation, this work-head is also designed to provide eccentric or planetary rotation to the spindle. The planetary motion, comparable to that of a jig grinder, makes it possible to produce precise holes using an electrode smaller than the hole, and simplifies the machining of internal contours and annular grooves.

Ram type work-heads are available for extra-large plunging cuts, typical of those required in the manufacture of forging and drawing dies, in which the cavity has a large surface area. Each of these

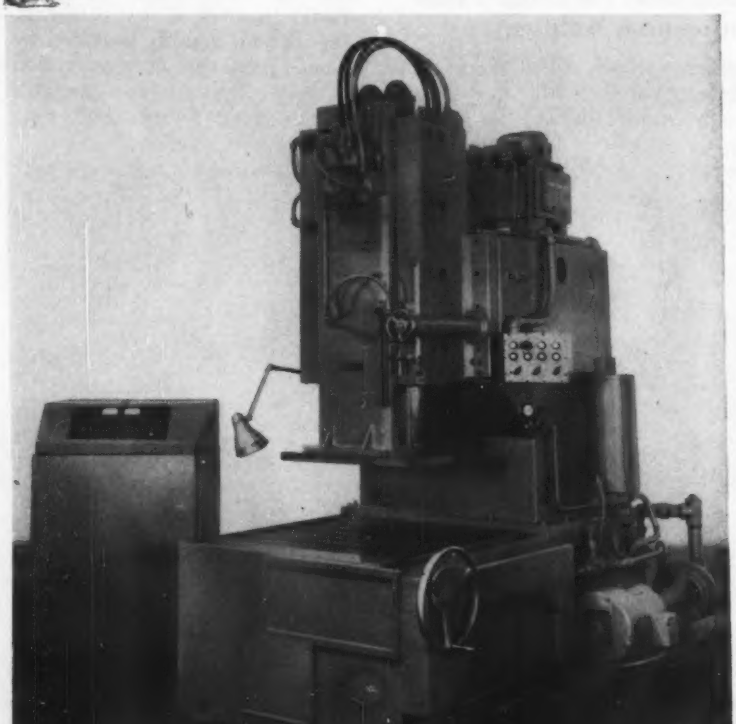
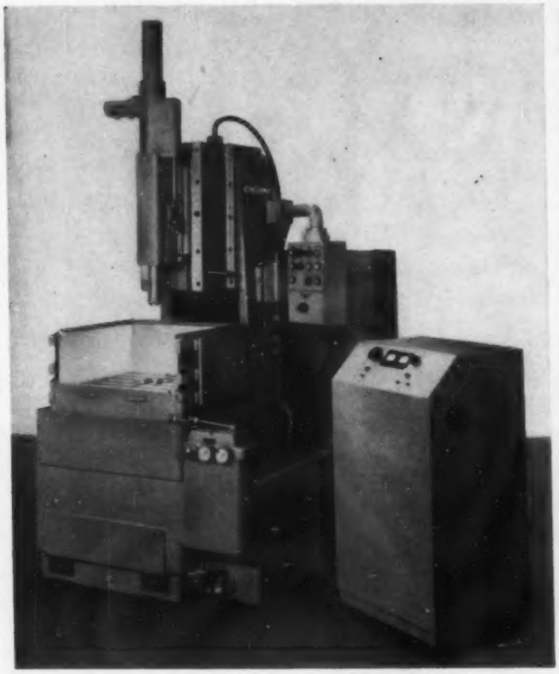


Fig. 1. Large "Elektrojet" die-sinking machine equipped with heavy-duty ram type work-head and disappearing tank



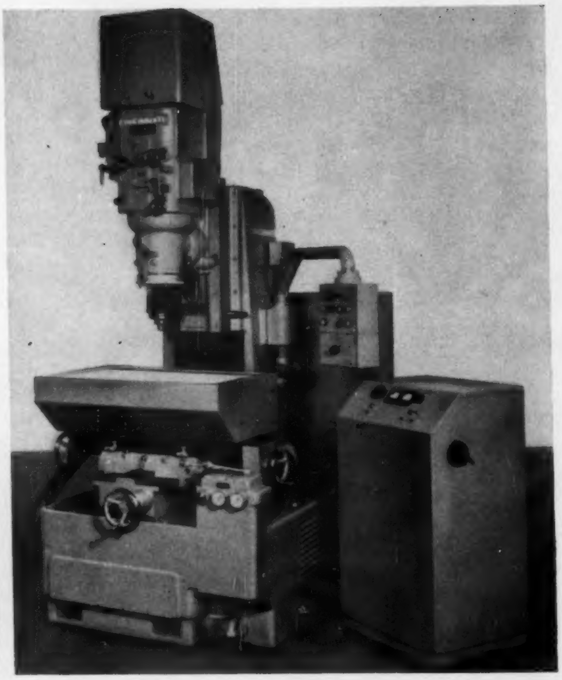


Fig. 2. (Left) Cincinnati Elektrojet with standard base and column equipped with drop-front tank, ram type non-rotating work-head, and movable slide. Fig. 3. (Right) Elektrojet with movable tank and universal work-head

work-heads may be matched with any of four tanks available for holding the dielectric.

A solid type tank is furnished for small, easily clamped work-pieces machined in production quantities. Drop-front tanks (see Fig. 2) are designed for greater accessibility. The front panel on this tank can be lowered to make it easier to load and position parts. The entire tank of the large Elektrojet die-sinking machine shown in Fig. 1 can be lowered into the bed of the machine by turning a handwheel. Lowering the tank makes the work-piece accessible from all sides, which is a distinct advantage when handling large-sized parts.

A moving table type tank is mounted on slides to give it a wide range of longitudinal and transverse movements, controlled by handwheels. The movable table makes it easy to locate the work-piece under the electrode, and in combination with the rotating or universal work-heads creates a highly versatile machine. This type of table can also be equipped with servo drives to move it under the electrode at a controlled rate.

Fixed and adjustable work-head slides are also available. Power-supply units can be furnished in capacities of 20, 40, 60, and 100 amperes.

The line is rounded out by two electrical-discharge grinding machines and a heavy-duty electro-spark die-sinking machine. The die-sinker is built with a larger base and column size than the basic line. It has a ram type work-head, disappearing tank, and is designed particulary for heavy-duty die work on blocks up to 18 inches thick.

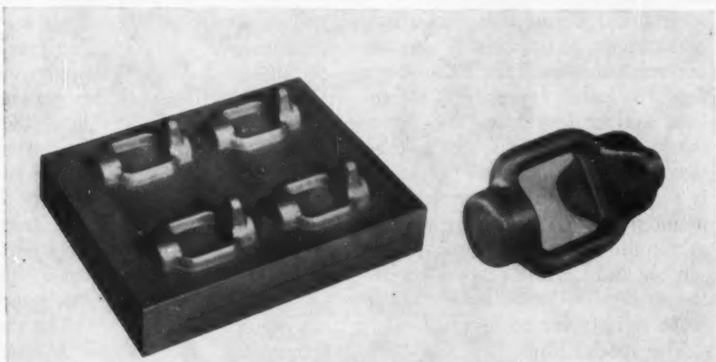
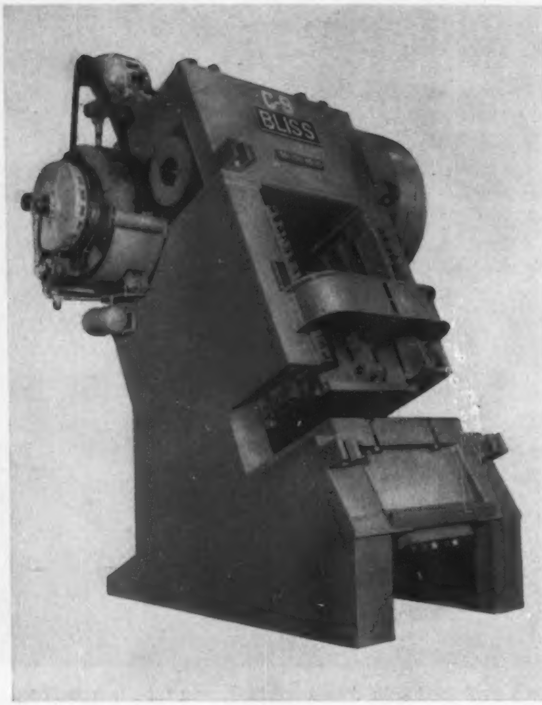


Fig. 4. (Left) Die-cast electrode for Elektrojet machining. (Right) Forging produced by die machined on Elektrojet machine

At the left, Fig. 4, is shown a die-cast electrode used in Elektrojet machining of a die. The die produced by this electrode required no further polishing or finishing. The forging shown at the right just as it came from this die gives a good idea of the finish given work produced by the Elektrojet machines.

Circle Item 577 on postcard, page 195



Special inclined gap-frame press built by the E. W. Bliss Co.

Machine for honing small parts brought out by the Barnes Drill Co.

Bliss Special Gap Press

The E. W. Bliss Co., Canton, Ohio, recently built a special, permanently inclined gap-frame press of 350 tons capacity for the McIntosh Stamping Co., Detroit, Mich. The press provides the basic convenience of a C-frame design for the handling of large and awkward shaped parts. It also has a maximum of design features suited to the heavy-duty requirements of automotive contract work. For example, the press, known as the SG1-350, has a welded steel, tie-rod frame construction, the latest type air friction clutch, and a counterbalanced slide and cushioned bed.

This equipment is designed to operate at forty strokes per minute continuous trip and twelve strokes per minute single trip. A heavy cam-actuated knockout and a motor-driven slide adjustment are provided. The bed area is 45 by 44 inches, the ram area, 45 by 35 inches, and the shut height, 24 inches. Depth of throat is 12 1/2 inches and height above floor, 19 inches.

Circle Item 578 on postcard, page 195

Production Honing Machine for Small Parts

A newly designed version of its Model 10 honing machine is being introduced by the Barnes Drill Co., Rockford, Ill., for manual or automatic honing of bores from 1/4 inch to 1 1/2 inches in diameter. The control panel of the new model has been raised to a more readable position and the front of its cabinet is fully enclosed.

Power for rotation and reciprocation of the hone is provided by mechanical connections requiring a minimum of upkeep. Pneumatic controls are used for the hone feed, including automatic expansion and collapse, and for automatic compensation for stone wear. Since no hydraulic circuitry is required, both floor space and maintenance costs are kept to a minimum. The transmission assembly and spindle suspended between double posts assure maximum rigidity for accuracy.

The model illustrated has tooling designed to hone bearing-rod ends and inner races with inside diameters from 0.4995 inch to 1.005 inches and remove from 0.006 to 0.008 inch of stock. At 80 per cent efficiency, production is 131 pieces per hour. Plugmatic automatic bore-to-bore sizing maintains size consistency within 0.0002 inch from bore to bore.

The Model 10 is also available with an air-operated, six-station rotary indexing fixture. It can be furnished with a variety of automatic equipment for such operations as magazine loading, automatic ejection, pre-gaging, post-gaging, automatic shutoff for stone replacement, and sorting (a predetermined number of bad parts will shut down the machine, depending on the specific honing application). Positioning of index stations for honing is controlled by two limit switches. The simplicity of fixture design permits economical change-over to different size parts.

Over-all floor dimensions for the Model 10, including electric panel, are only 32 by 45 inches. The machine has a 0 to 2 1/2-inch mechanically reciprocating stroke with a 6-inch, air-operated withdraw stroke, and maximum swing of 10 inches.

Circle Item 579 on postcard, page 195

Zagar Nut-Tapping Equipment

Up to 50,000 nuts per hour can be tapped automatically at 100 per cent efficiency by a line of tapping equipment announced by Zagar, Inc., Cleveland, Ohio. Flexibility in tooling which easily accommodates nuts ranging in pitch from 8-32 through 1 inch, eight threads per inch, and lead-screw control of the head with all taps rotating simultaneously are features incorporated in this equipment. Nuts are deposited into a hopper which feeds to one of six sections of a circular feed-index plate. In the second position the nuts are brushed so that they are positioned flush with the top of the locator plate. At the third segment the nuts are agitated to orient them firmly in the locator holes. At the fourth station the oriented nuts are locked in the plate and at the fifth station they are tapped. The sixth segment is arranged to discharge the nuts into a chute or other transporting mechanism. Each nut is held rigidly in a vertical position by a spring-tension device while locked in the plates.

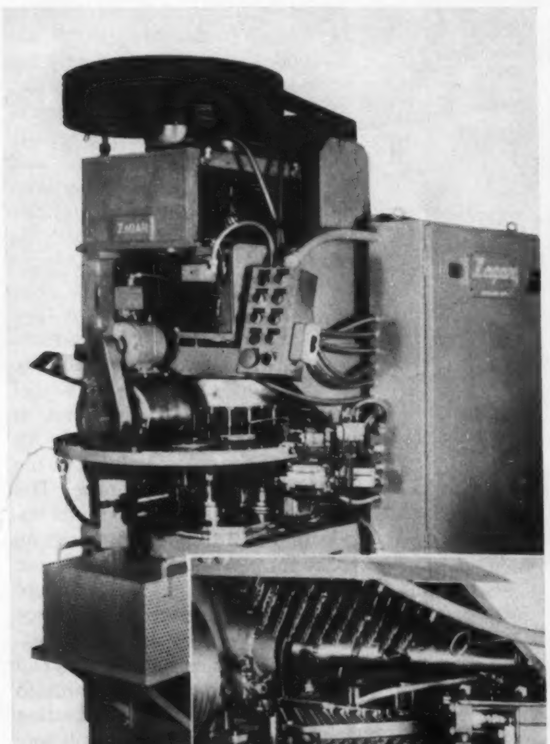
The inset shows the tapping head in open position where tap changing can be done quickly and easily. Equipment for automatic feed to the hopper and removal of nuts, as well as chip removal, can be obtained from Zagar. The design of the machine, however, makes adaptation of the user's system possible as well. The head is powered by a 10-hp motor. Reverse is by heavy-duty, electrical-reversing clutches. The cycle described is fully automatic.

Circle Item 580 on postcard, page 195

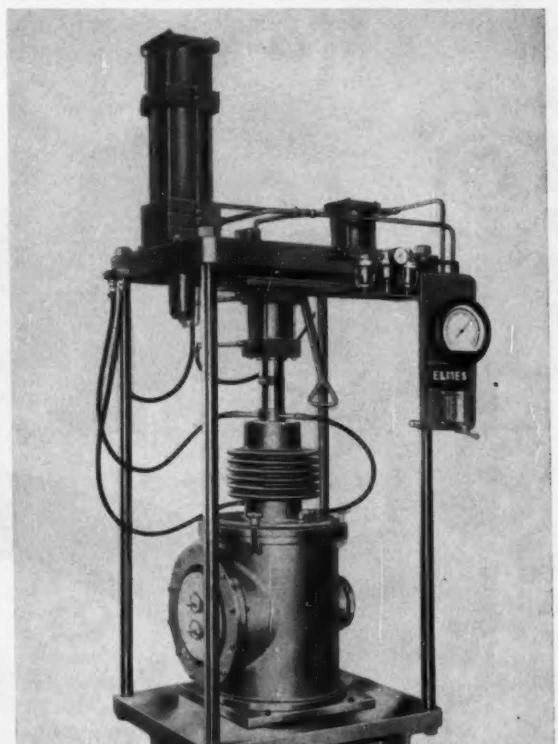
Elmes Custom-Built Induction-Heated Vacuum Press

A unique hydraulic press designed by the Elmes Engineering Division of American Steel Foundries, Cincinnati, Ohio, has been custom-built for use in the laboratory of a large electrical-equipment manufacturer. The prime purpose of this press is research processing of certain sintered metallic compounds in connection with the defense program. Each compact, or stack of compacts, is loaded into the vacuum chamber and within the confines of the inductor coil. After being concentrically positioned, the vessel is covered and pressure is applied to a susceptor encircling the compact or compacts. Simultaneously, a vacuum pump is conditioned to "pull" a vacuum within the steel vessel which approaches the high-level range—between 1 and 10 microns of mercury, based on reference to a mass spectrometer.

After the proper vacuum is



Automatic nut-tapping equipment built by Zagar, Inc.



Elmes-designed induction-heated vacuum press

achieved, power is supplied to the induction coil from the main motor-generator converter. Power from this converter causes the internal susceptors to become heated to 3000 degrees F. which temperature is conducted to the compact or stack of compacts being processed. After being subjected to this intense heat, in a near-true vacuum, a purification reaction occurs which greatly improves the quality of the material from a thermal standpoint. Also, physically (where more than one is being processed), the compacts can be fused together to form one solid stack. Many accessory items, such as equipment for water cooling of the ram, chamber jacket, and baseplate, are included.

Circle Item 581 on postcard, page 195

Schenck hydraulic dynamometer

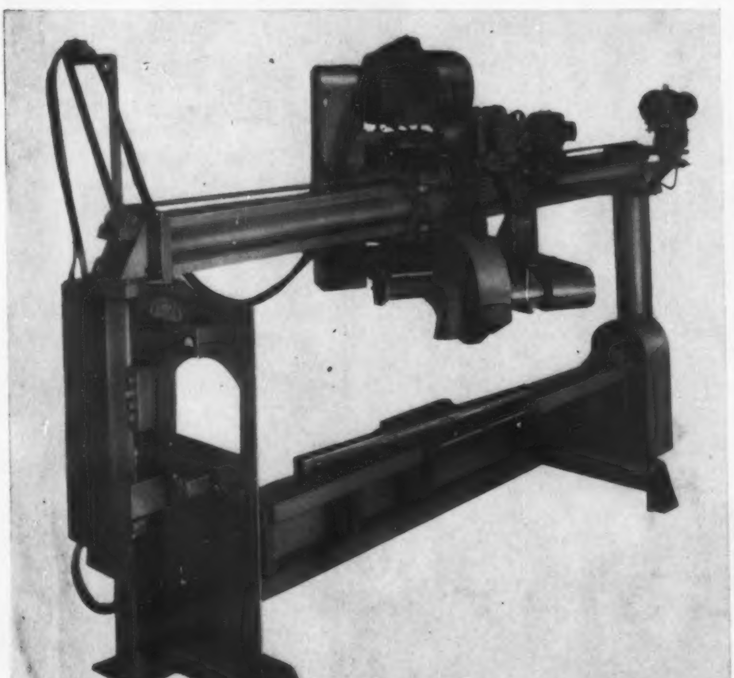
Ty-Sa-Man Semi-Automatic Billet Grinder

A portable, semi-automatic billet grinder has been patented by the Ty-Sa-Man Machine Co., Knoxville, Tenn. This equipment takes billets or slabs up to 12 inches wide by 12 inches thick, in lengths up to 20 feet. The push-button controls are simple, easy to operate, and conveniently located at the operator's station, which is protected by a metal shield. A patented angle-wheel, driven by a 40-hp motor, exerts a constant floating pressure when grinding.

The machine holds and turns billets and easily grinds their corners. The table, which rotates 360 degrees, has billet flippers, mechanical clamps, and stops that facilitate handling the work. This equipment permits the billets to be mechanically flipped and turned to any position without requiring the operator to leave his station.

Grinding head and main motor move on an accurately machined transverse rail with 16-point roller-bearing travel. Raise-and-lower action and travel mechanisms are chain-driven and powered by separate motors. Machine can be tailored to suit customer's needs.

Circle Item 582 on postcard, page 195



Semi-automatic billet grinder built by Ty-Sa-Man Machine Co.

Schenck Hydraulic Dynamometers

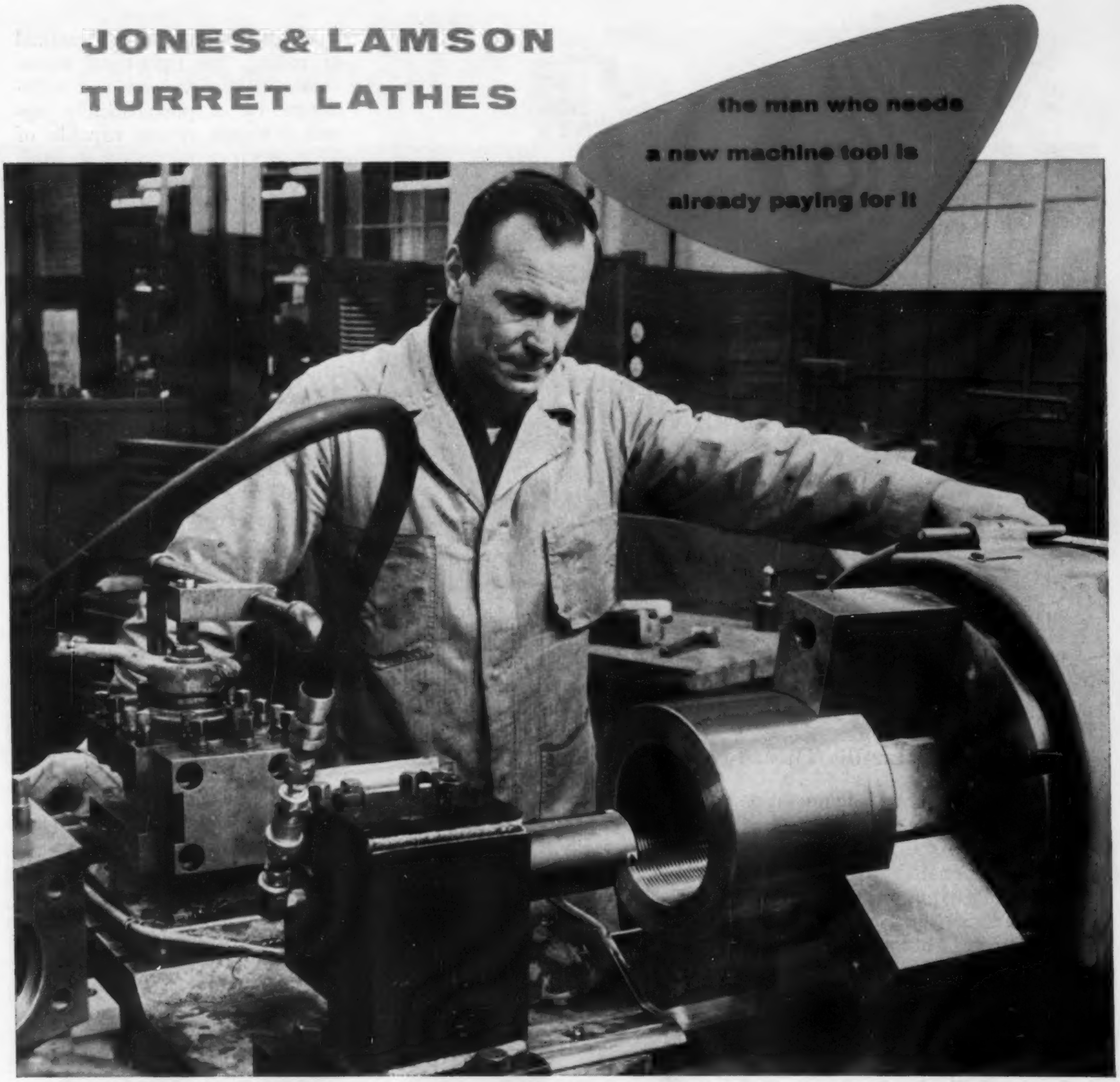
The Cosa Corporation, New York City, national representatives for Schenck fatigue-testing and balancing equipment, recently announced the addition of a new line of Schenck hydraulic dynamometers. These dynamometers feature a rotating outer-case assembly and high efficiency power-absorption characteristics that assure stability with any prime movers such as combustion engines, electric motors, pumps, and turbines.

The design is of the turbine type with an open or closed water circuit as the power absorber. Torque is indicated on a precision dial scale. One lever adjustment is quickly and infinitely variable for control of the water volume in the turbine and braking torque. The rotating case assembly permits application of a simple prony friction brake for power extension at lower speeds. Dual-range scales assure the highest degree of accuracy with high- or low-power motivation. Very low or high speeds can be stepped up or down through an integral gear-box, eliminating power loss through transmission. Eleven standard models cover ranges of 30 to 5500 hp and 16,000 to 1000 rpm. Other models can be produced to suit specifications.

Circle Item 583 on postcard, page 195

(This section continued on page 188)

JONES & LAMSON
TURRET LATHES



Single point threading to a finish of 15-20 RMS is completely automatic—and fast

The I. D. of these large cap-nuts is approximately 5¼". The material is High Chrome Nickel Steel, Rockwell C 30–32. The thread is 8 pitch, 5½" long, *and tapered .005" per inch.*

It's a tough job to make time on, but a J & L Turret Lathe equipped with an Auto-Threader, does the threading in 5 minutes!

Here's how: The part is faced and a rectifying bore is made; in the same chucking, threading is completed in 16 automatically-controlled passes, with a graduated cutting depth for each pass. *Pitch diameter is held to .002",* and finish is 15–20 RMS on the flanks.

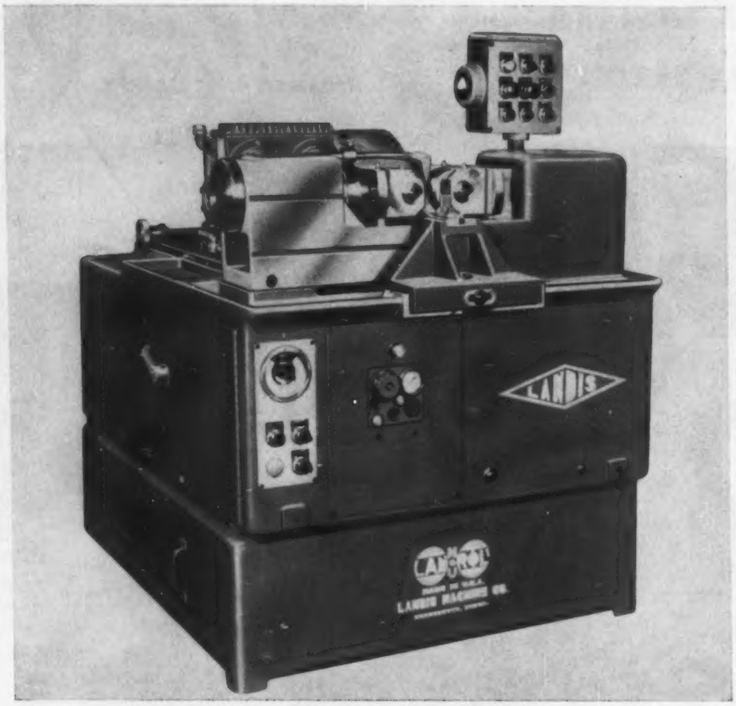
On the old machine, milling the thread alone took 75 minutes. With this new setup, the entire operation — including loading, facing, boring, threading and unloading — is only 15 minutes.

Jones & Lamson Turret Lathes are available with: Completely automatic controls; 45°, 60°, and 180° Tracers; taper attachments, and a variety of other tooling complements, all designed to increase productivity.

Write for detailed information, Jones & Lamson Machine Company, 512 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

 For more data, circle this page number on inquiry card



Landis "Lan-Nu-Rol" thread-rolling machine

Landis Thread-Rolling Machine

The Landis Machine Co., Waynesboro, Pa., has developed a small-range thread-rolling machine designated the "Lan-Nu-Rol." This equipment is capable of handling work up to 2 inches in diameter (8 threads per inch or finer) with the "infeed" method of rolling and up to 3/4 inch (10 threads per inch or finer) when using the "thrufeed" method. The machine is pneumatically or (optionally) hydraulically operated and designed to facilitate operating and servicing.

Spindle speeds are infinitely adjustable from 166 to 500 rpm through a pulley arrangement which requires no gear changing. The range of spindle speeds allows each diameter within the machine's range to be roll-threaded at the most efficient speed. A simple, efficient worm-gear transmission is incorporated which has only two gear contacts of high overload capacity.

The machine utilizes two cylindrical thread-rolling dies mounted on inclinable roll-holders adjustable to 10 degrees left- or right-hand. The 10-degree inclination easily handles all AN, UN, and Acme thread forms within the machine's capacity.

When using the "infeed" method of rolling, the right-hand moveable die is advanced and withdrawn by a pneumatically operated toggle system capable of 60 cycles per minute. Extremely high rolling pressures are obtained with a minimum of deflection and stress and a maximum of thermal stability.

Manual, semi-automatic or automatic cycling is available along with a full complement of automatic feeding equipment for "thrufeed" rolling operations. Extensive tooling has been developed and is designed to be simple and versatile with standard interchangeable components for "infeed" or "thrufeed" rolling.

Circle Item 584 on postcard, page 195

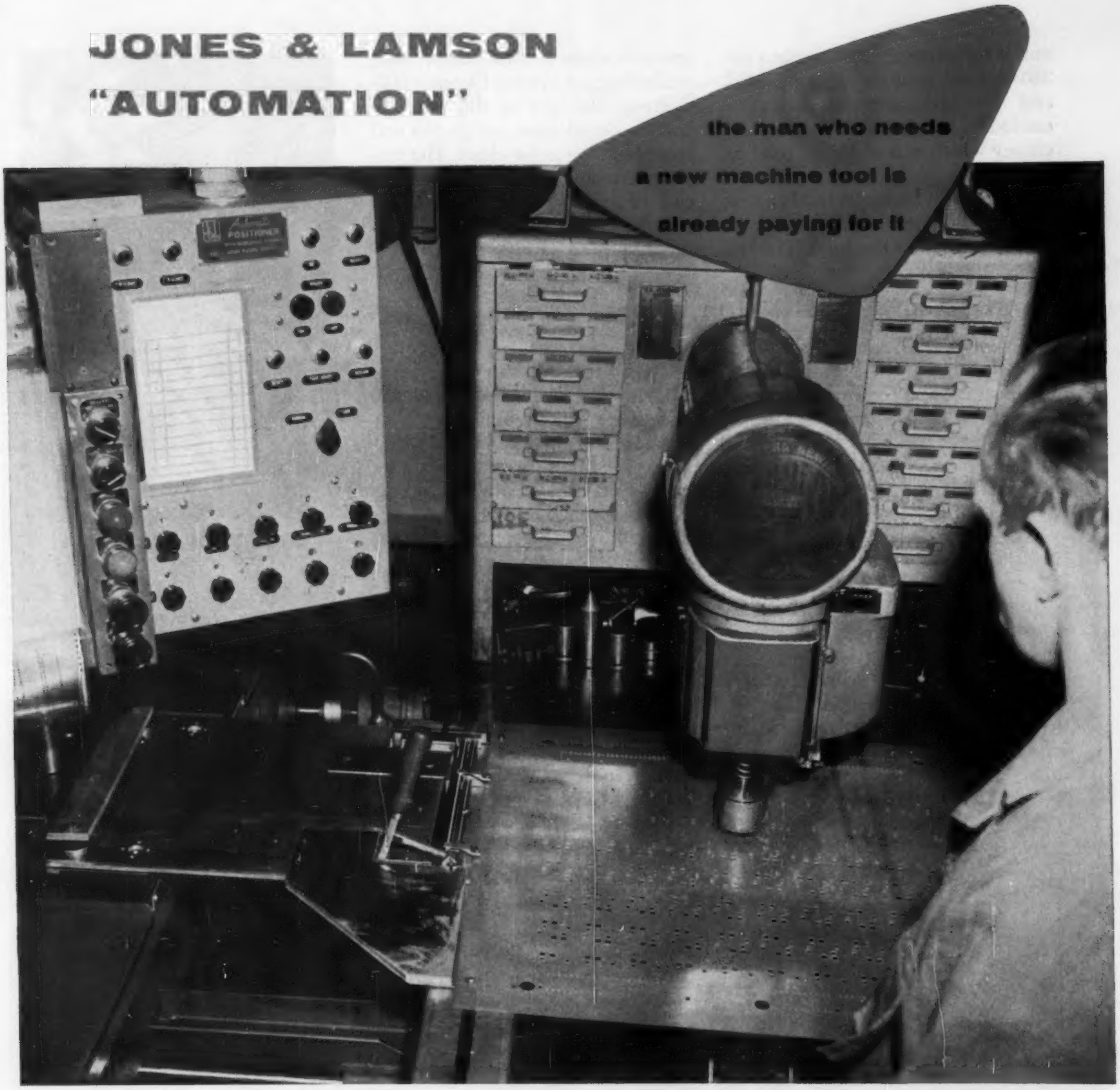
RCA Electronic Piston-Contour Inspection Machine

A machine that measures and records changes or variations in the diameter of automotive-piston skirts has been announced by the Radio Corporation of America, Industrial and Automation Division, Detroit, Mich. With slight modifications this machine can also be used for inspecting a wide variety of other parts for concentricity and


RCA electronic piston-contour inspection machine

JONES & LAMSON

"AUTOMATION"



This Tape Controlled Setup Punches 1483 holes – of 11 different sizes – in just 85 minutes

How's this for small lot automation? The problem is to produce 50 parts, each having 1483 holes of 11 different sizes. Hole location must be ±.002". Delivery — 2 weeks.

J & L's numerical control positioning table, applied to a standard punch press, does the job with minimum lead time, production time, and cost. Here's how:

The entire tape programming for this complicated part takes only 15 hrs. There are no fixtures, templates, or dogs to be made and set. No gang tooling to prepare. No appreciable setup time.

The operator simply inserts the prepared tape, locates the work piece and pushes a button. The positioning table is then automatically controlled in any pre-arranged, random pattern. Therefore there are only 11 tool changes for the 11 sizes of holes. And — this unit tells the operator when and what tool to change.

A completed part comes off the machine every 85 minutes. Changeover for other jobs is just a matter of changing tapes and tools.

Investigate how tape control can help increase the efficiency of *your* operation. Write to Jones & Lamson Machine Company, 512 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

out-of-roundness. The complete 360-degree contour is measured and the measurements are recorded in sixty seconds with an accuracy which can easily be read to 0.0002 inch.

A piston to be inspected is accurately positioned and clamped in the fixture of the machine. The inspection cycle is then started and, while the part rotates through 360-degrees, changes in the skirt diameter per degree are gaged and recorded on a polar chart. The machine automatically stops at the end of each cycle to permit removal of the piston.

Circle Item 585 on postcard, page 195

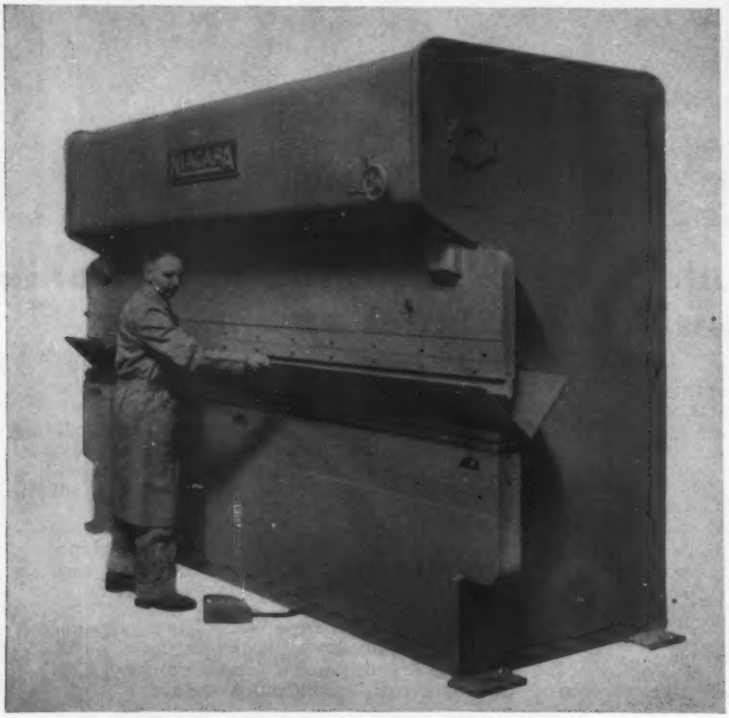
Oxweld flame-cutting nozzle

Niagara Redesigned Press Brakes

Redesigned Series IB press brakes in 15-, 30-, and 60-ton models make up the expanded line announced by Niagara Machine & Tool Works, Buffalo, N. Y. Modernized "inboard" design envelopes all rotating parts between the housings of these presses. The one-piece, all-welded steel frame with integral wrap-around crown is designed to provide maximum resistance to deflection and positive alignment of bearings, bed, and ram.

Models are furnished with either power or manual clutch-brake-treadle arrangements, depending on the size of the machine and type of work to be handled. Laminated, non-metallic ways prevent welding or galling of the bearing surfaces. Motor-control buttons, ram-adjustment switch, and adjustable-speed-drive crank wheel are front-mounted within easy reach of the operator. A wide choice of other features and arrangements is available. Bending capacities range up to 3/16-inch-thick mild steel. Over-all bed and ram lengths range from 4 to 14 feet.

Circle Item 586 on postcard, page 195



Inboard press brake of redesigned Niagara line

Linde Flame-Cutting Nozzles

A series of improved flame-cutting nozzles for use with acetylene or fuel gas has been introduced by the Linde Co., Division of Union Carbide Corporation, New York City. Included in the new series are bendable nozzles for riser removal, and nozzles for fin washing, general-duty cutting, and high-speed mechanized shape-cutting. Increased cutting speeds are possible with the new Series 1534 and 1535 Oxweld two-piece nozzles designed for use with natural gas. Each of the two-piece nozzles has from twelve to twenty extremely small outlets for preheat gases—more than double the number in conventional one-piece nozzles. The increased number of preheat outlets produces a nearly solid ring of preheat flames, which is ideal for high-speed shape-cutting, since it assures uniform preheat regardless of rapid changes in the direction of cut. Cutting speeds are increased substantially by a unique divergent-nozzle bore design.

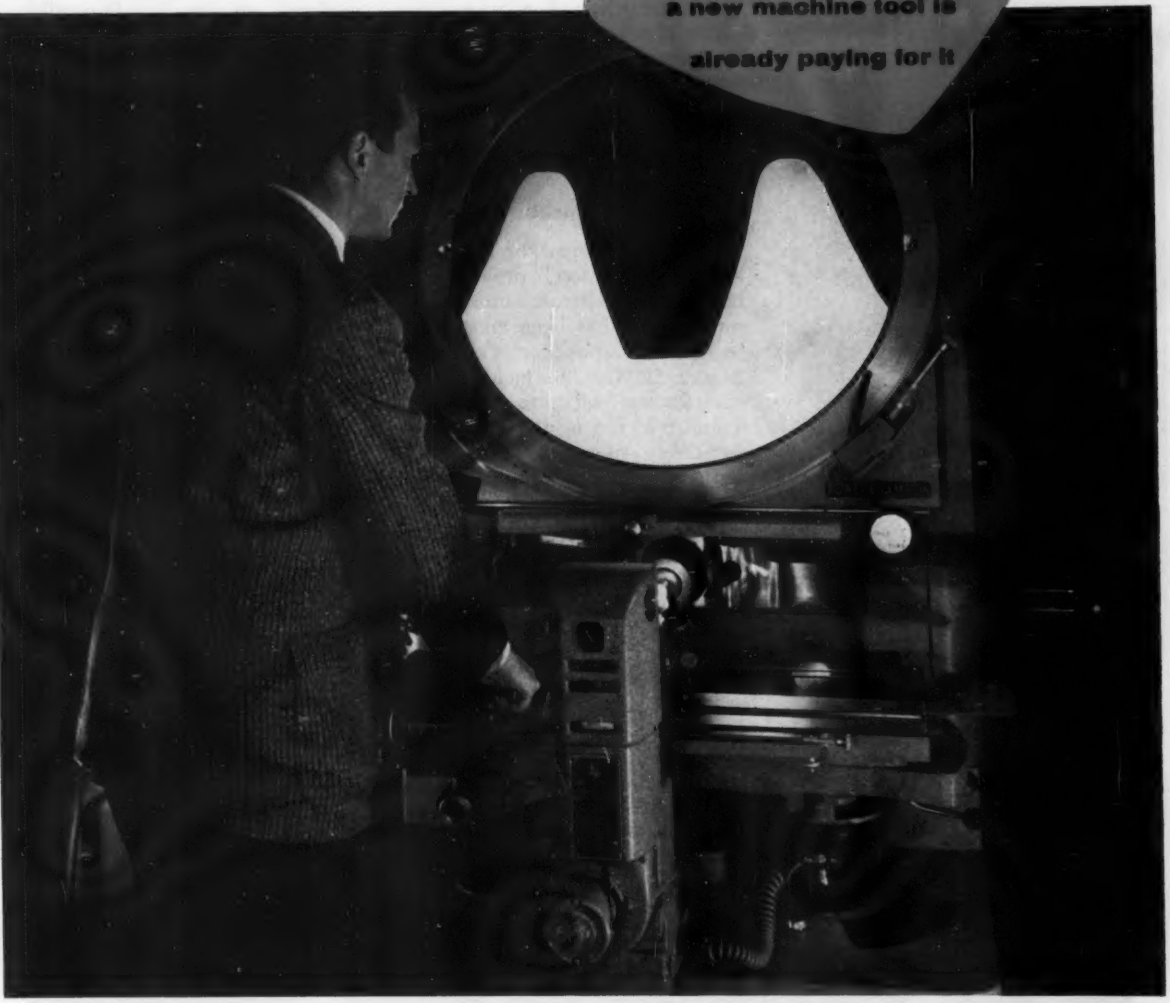
The rates of metal removal in fin-washing operations are said to be doubled with the next Oxweld 1523 and 1524 series nozzles. These nozzles have a deeply recessed cutting oxygen bore for added fin-washing capacity. Bendable nozzles for riser removal and cutting in hard-to-get-at places are also included in the new selection. Known as the 1940 series, these 10-inch long nozzles have ten preheat outlets and are for use with natural gas, propane, and other fuel gases.

Circle Item 587 on postcard, page 195

(This section continued on page 192)

JONES & LAMSON OPTICAL COMPARATORS

the man who needs
a new machine tool is
already paying for it



This revolutionary new light source makes optical inspection more efficient than ever

Jones & Lamson now offers the J & L Mercury Arc Lamp, an entirely new light source unit that gives *more than 5 times the intensity of the best filament light source available today.*

This new unit, designed for use with any J & L 14-inch or 30-inch screen Comparator, actually gives a *new* kind of light . . . an extremely bright, *steady* arc, with *no* flickering. Its high intensity produces an incomparably bright screen with razor-sharp black shadow, even at highest magnifications.

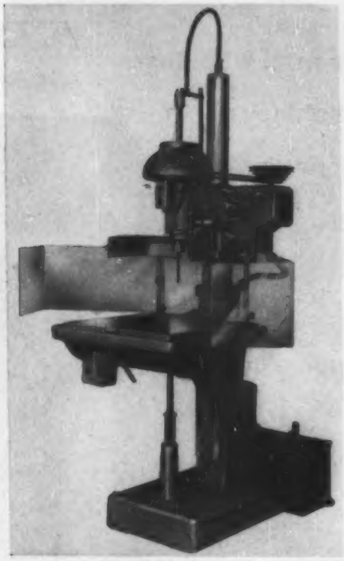
Thus, you can greatly increase the accuracy of your inspection and measuring with the J & L Comparator, even to the point of actually "splitting tenths". (For use at low magnifications, the light can be filtered readily.)

The J & L Mercury Arc Lamp comes as a complete, compact packaged unit, which plugs into any 110 volt outlet. It is quickly interchangeable with the standard light source of any Jones & Lamson 14-inch or 30-inch screen Comparator, and is a universal device which accomodates various standard makes of mercury arc lamps.

For detailed information and specifications, or a demonstration, contact your local J & L representative or write direct to Jones & Lamson Machine Company, 512 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

 For more data, circle this page number on inquiry card



Buffalo drilling machine designed for drilling extra-hard materials

Buffalo Machine for "Cold Point" Drilling

A Buffalo hollow-spindle drilling machine designed for use with Mossberg "Cold Point" and Hoffman diamond-impregnated bits has been brought out by the Buffalo Forge Co., Buffalo, N. Y. This unit is said to be capable of drilling super-hard materials at speeds up to 10,000 rpm. It has an accurately balanced hollow spindle and a coolant system with a pump which supplies coolant at a pressure of 100 psi. This equipment serves to flush away chips as well as cool the tool and work. Special splash guards and a rubber-flex collet chuck are included in the equipment.

Because coolant under high pressure is not necessary when drilling glass or ceramics, city water piped to the spindle makes it unnecessary to use the pressure pump when drilling these materials. It is claimed that with this machine previously impossible drilling jobs can be handled at production speeds and that regular drilling work can also be done much faster.

Circle Item 588 on postcard, page 195

Tube Benders for Aircraft Work

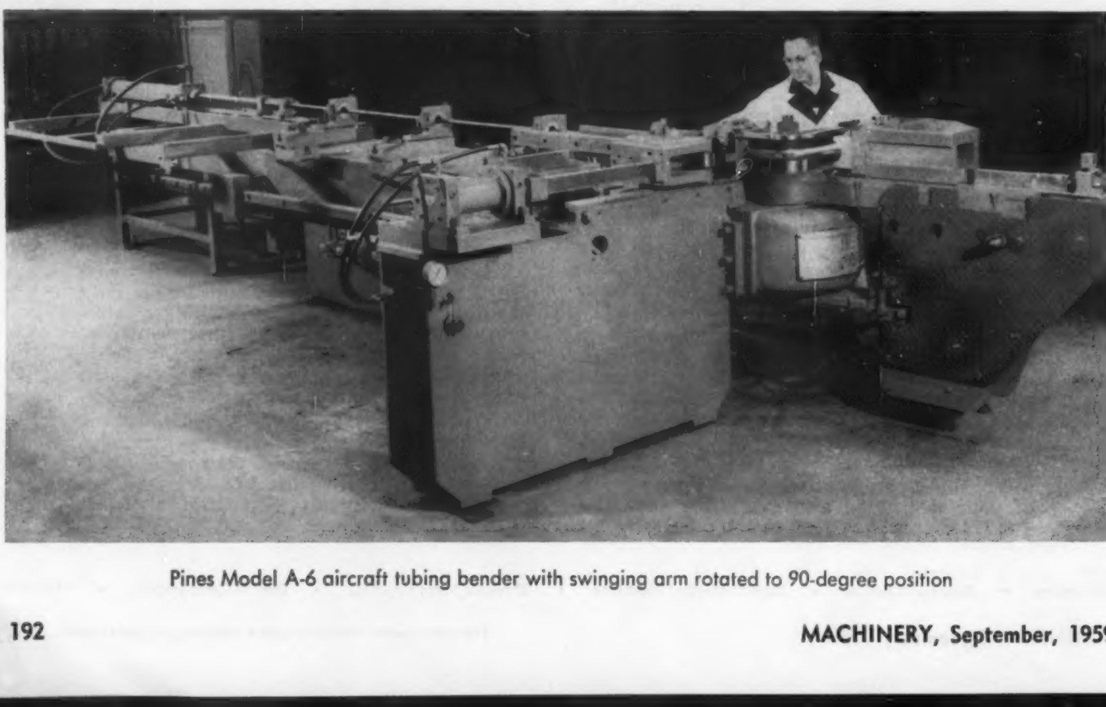
The development of a line of improved precision hydraulic tube-benders for aircraft, missile, or similar work has been announced by Pines Engineering Co., Inc., Aurora, Ill. The line includes four sizes for bending tubing 1 1/2, 3, 6, and 8 inches in diameter. A direct-acting pressure-die accessory of this equipment is said to give a high degree of accuracy in making short-radius bends in ultra-thin-wall tubes.

The use of a hydraulically operated, direct-acting pressure die greatly reduces setup time and scrap loss. The exact amount of force on the pressure die can be read and recorded from a gage, thus simplifying subsequent setups on the same or similar parts. The direct-acting die also reduces the tendency for tubing to wrinkle or rupture during a bend as it applies pressure directly in line with the tube center line. It also automatically compensates for slight variations in wall thickness or minute machine or tooling deflections. As the retaining force applied by the pressure die is the force that produces the bend, the precise control available is especially valuable when bending thin-wall tubing.

Other features of these machines that contribute to high-quality, tight-radius bends include hand-scraped ways, slides, and die mounting surfaces. Calibrated scales, push-button control of all machine operations, and extremely precise machining of all connecting parts are also important factors. These features make it possible to bend repeatedly to accuracy limits of plus or minus 1/4 degree in 180 degrees with radii as small as the diameter of the tubing.

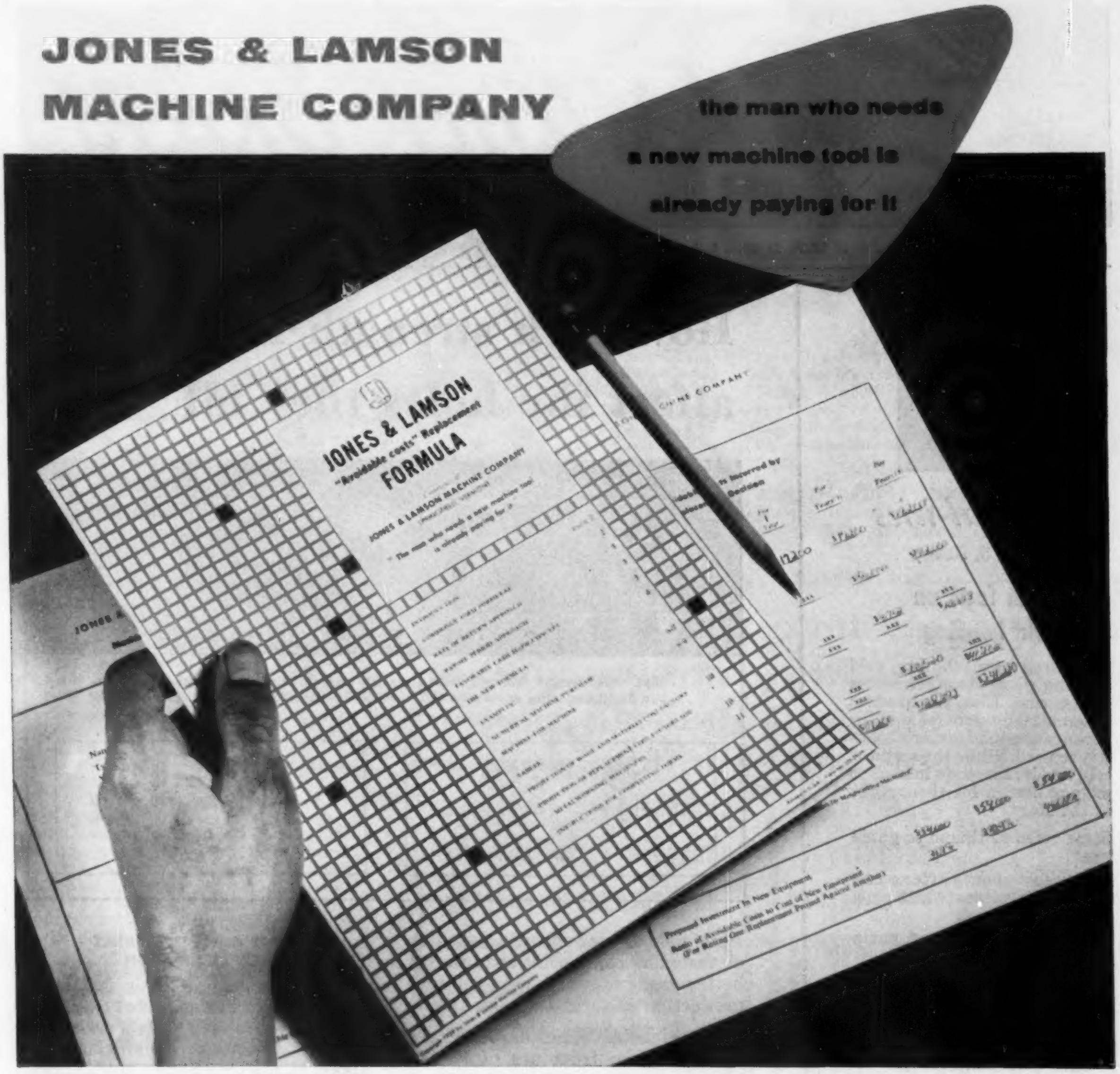
Circle Item 589 on postcard, page 195

(This section continued on page 200)



Pines Model A-6 aircraft tubing bender with swinging arm rotated to 90-degree position

JONES & LAMSON MACHINE COMPANY



How to get Equipment Dollars from Management

To management men, nothing speaks so eloquently as facts. Take the men in *your* front office, for instance. When told that a new machine tool (or several new ones) is a "must", they may very well be inclined to agree. But they have to be *shown*.

In order to sell management, you must present an accurate, factual statement, comparing current productivity of existing equipment, with the productivity attainable with new, advanced equipment.

And this is where you must exercise extreme caution.

Why?

Because, practically without exception, the formulas commonly used for evaluating machine tool performance contain flaws, fallacies and limitations which are seriously misleading. They give an erroneous picture because they distort the facts.

Happily, J & L has the answer to this problem. It's the new J & L "Avoidable Costs" Replacement Formula, which gives you an easy, step-by-step method of productivity evaluation which is logical, accurate and reliable. This formula is tried and true. It gives you a clear, true picture and supplies you with the facts you need in order to get that new machine you're looking for.

For your copy of J & L's "Avoidable Costs" Replacement Formula, together with easy-to-use work sheets, write Jones & Lamson Machine Company, 512 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

For more data, circle this page number on inquiry card

RB&W FASTENER BRIEFS

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

Technical-ities

By John S. Davey

Quick facts on cold heading

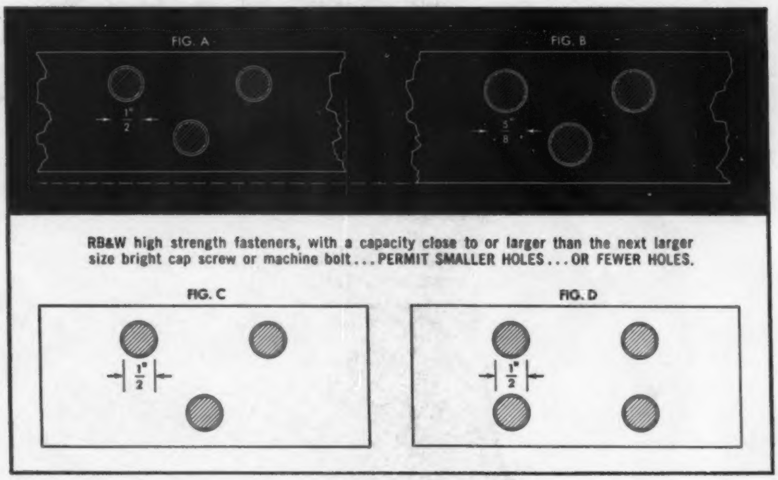
Compared to machining, cold heading gives stronger pieces at less cost. Also, the headers automatically control quality because unsound material cannot be used. While the scope of cold headers is wide indeed, it pays to design for them right at the start.

Some rules of thumb to guide you:

1. You save money after a run of 25,000 pieces (which pays for the set-up).
2. Maximum length of parts runs about 6 inches. Maximum volume of upset is equivalent to length of stock 4½ times its own diameter. (With special operations, up to 26 diameters have been achieved!)
3. Various metals and alloys are suitable. But keep carbon content in steel to under 0.45.
4. Concentric pieces are easier to form, though eccentric and serrated shapes are practical.
5. Avoid sharp corners. Allow generous radii.
6. Because upsets are usually cylindrical, oval or round shapes take less trimming than square or rectangular.
7. Hollow upsets tend to form cracks at edges of recess, so avoid them.
8. Embossing raises costs.
9. No problem heat treating short sections. But long sections are apt to be distorted.

When in doubt, contact an expert in cold heading.

How high strength fasteners affect the holes they fill



RB&W high strength fasteners, with a capacity close to or larger than the next larger size bright cap screw or machine bolt... PERMIT SMALLER HOLES... OR FEWER HOLES.

As simple a matter as the selection of fasteners can permit changes for better design... and also improve production costs and service life.

In sketch "A", for example, you see one difference from use of RB&W high strength fasteners instead of machine bolts or bright cap screws, as in "B". You use a smaller size fastener. Holes are therefore smaller. The metal section, in turn, can then be smaller for a saving in material and weight. The costlier the materials (copper bus bars as a case in point), the more significant the cost savings.

In sketch "C", fill the 3 holes with ½" high strength bolts, and you have a load capacity close to 40,000 pounds. That's the same as developed by 4 bright cap screws filling holes in Sketch D. It costs less to drill and less to fill the 3-hole design.

RB&W High Strength Fasteners are now identified by this new marking as well as 3 radial dashes. They have the proper balance between ductility and hardness required in high carbon units.

EFFECT ON PERFORMANCE AND PRODUCTION

When tightened to their full load, high strength fasteners not only *stay* tight—even under vibratory conditions—but also exert high clamping force. It has been shown that, under high compressive forces, hole areas gain extra resistance to fatigue cracks.

What's more, the high friction developed virtually locks members together, prevents slippage. Holes, therefore, need not be perfectly aligned since they can even be slightly oversized without detriment.

There's an RB&W Fastener Man ready to aid you in working with high strength bolts—in the design stage or as replacement for SAE grade 1 or 2 steel fasteners or for rivets. Write for helpful booklet DC-1, Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, New York.

Plants at: Port Chester, N.Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Additional sales offices at: Ardmore (Phila.), Pa.; Pittsburgh; Detroit; Chicago; Dallas; San Francisco.

NEW CATALOGUES

HYDRAULIC VALVES—Rivett, Inc., Boston, Mass. Manual No. 230 illustrating and describing the operation and application of pressure-controlled hydraulic valves. Copies available upon request on company letterhead from Rivett, Inc., Brighton 35, Boston, Mass.

PIPE WELDING—Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City. Booklet (Form ADR 118) incorporating two technical articles on small-pipe welding, written by A. N. Kugler, chief welding engineer, Airco. They are entitled "Fabrication of Small Piping by Welding and Brazing" and "Designing for Welded Systems of Small Size Pipe" and appeared originally in successive issues of the magazine AIR CONDITIONING, HEATING AND VENTILATING. The first of the articles, "Fabrication of Small Piping by Welding and Brazing," defines and describes the welding processes applicable to the joining of small pipe. The second, "Designing of Welded Systems of Small Size Pipe," covers the principles of welding and brazing design, and how these can be applied to the various pipe metals. **501**

SOLVENTS—Union Carbide Chemicals Co., Division of Union Carbide Corporation, New York City. 40-page booklet describing the properties and uses of Cellosolve and Carbitol glycol-ether solvents and containing comprehensive data for fourteen solvents, including physical properties, chemical derivatives, end-use possibilities, storage and handling, physiological properties, specification limits, and test methods. A detailed reference section is included. **502**

ALUMINUM WELDING—Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City. A 120-page book (Form ADI 1258), surveying the techniques of welding aluminum using Air Reduction's Aircomatic (gas-shielded metal-arc) and Heliweld (tungsten-inert-gas) processes. Major topics covered include: weldability of aluminum and its alloys, definitions and technical discussions of the two welding processes, selection of the proper process for certain job applications, descriptions of manual and automatic equipment, welding power supplies, and safety practices. **503**

CHEMICAL MILLING—Chemical Milling International Corporation, El Segundo, Calif. Brochure entitled "Better Chemical Milling Through Research," describing this new company's services, which include: research, consultation, and production of chemically milled parts. C.M.I. has been organized as a publicly owned corporation by Frank L. Bailey, president, and E. Lawrence Brevik, technical director. **504**

TUBE AND BAR STOCK—Centrifugally Cast Products Division, Shenango Furnace Co., Dover, Ohio. Bulletin No. 156, offering detailed information on standard bar and tube stock now available in three special materials: GC Meehanite Metal, GA Meehanite Metal, and Type #1 Ni-Resist. In addition to illustrating applications and outlining material features, this bulletin contains a comprehensive physical properties chart as an application guide. **505**

MULTIPLE-POINT TOOLING—Valenite Metals, Royal Oak, Mich. Catalogue V.B.U. 59A, explaining how the com-

pany's V.B.U. system of tooling cuts costs and speeds production on complex multiple-point and multiple-diameter tooling. Outlined in detail are the many advantages and applications of this system which makes possible the use of standard throw-away insert tools and tool elements on multiple-point tooling, in which boring, chamfering, facing, and other operations are combined. **506**

SAFETY PRODUCTS—Bausch & Lomb Optical Co., Rochester, N. Y. 40-page catalogue A-1762, listing the complete line of B & L safety products for industrial and laboratory job requirements. Included are descriptions of plastic, metal, and combination safety glasses, specially designed goggles and eye shields, and complete specifications for "Bal-Safe" lenses, as well as the new Enduron plastic lenses. **507**

SHAPE CUTTING MACHINE — The Linde Company, Division of Union Carbide Corporation, New York City. Booklet CF-1294 describing how tens or thousands of intricate metal parts can be easily reproduced from simple pencil sketches on ordinary paper with a new, fully automated flame-cutting machine, the Oxweld CM-60. Oxy-acetylene cutting torches on the CM-60 faithfully follow electronic impulses from the Linde Photocell Tracer. **508**

CARBIDE PRODUCTS—Metal Carbides Corporation, Youngstown, Ohio. 68-page catalogue (59-G) covering the company's complete product line including brazed tools and tips, "Klamp-Lok" tool-holders, throw-away blanks, centerless blades, rolling-mill rolls, heavy metal, and technical data regarding the proper application of Talide metal to cutting, drawing, and wear-resistant applications. **509**

WAYS AND GIBS—Ohio Knife Co., Cincinnati, Ohio. Catalogue detailing the many additional O. K. standard-way and aluminum-bronze way cross-section sizes now available. A section is devoted to the company's newly developed, low-cost, center-clad hardened and ground standard stock used in today's modern electronic and ultrasonic machines and machining techniques. **510**

CLUTCHES—Marquette Division, Curtiss-Wright Corporation, Cleveland, Ohio. 27-page catalogue describing five standard lines of spring clutches in bore sizes from 1/8 to 1 inch and torque capacity up to 1250 pounds-inches, specifically designed for use in machinery, equipment, and instrument applications utilizing drive up to 5 hp. **511**

HOISTS—Coffing Hoist Division, Duff-Norton Co., Danville, Ill. Brochure (ADH-75) featuring the Coffing S series heavy-duty "Quik-Lift" electric hoist. It contains complete specifications on the twelve models of the S series hoist in addition to a sectioned drawing which shows major features. **512**

WELDING—Hobart Brothers Co., Troy, Ohio. Catalogue presenting arc-welding machines and giving complete specifications and information on the various types available. It also describes a line of induction-heating equipment, pipe-thawing equipment, and a power source for cutting and gouging. **513**

FLAME-HARDENING—Chicago Flame Hardening Co., East Chicago, Ind. Catalogue featuring engineering chart which shows ranges for hardness and depth usually required in flame-hardening. The illustrations demonstrate the sizes and kinds of machine ways, rolls, gears, sprockets, rings, cams, dies, and wheels that are regularly flame-hardened. **514**

BORING-BARS—Giddings & Lewis Machine Tool Co., Davis Division, Fond du Lac, Wis. Catalogue (Davis D-520) describing both general-purpose and production bars for either line- or stub-boring operations. Both heat-treated and flame-hardened bars with a choice of standard shanks are priced according to diameter and length. **515**

DESCALING — Pangborn Corporation, Hagerstown, Md. Bulletin No. 609, describing the complete line of Rotoblast descaling machines. Photos, diagrams, cut-aways, and sketches show details and operating features of the Rotoblast wheels which provide the cleaning force of the equipment. **516**

DRILLING—Cincinnati Lathe & Tool Co., Cincinnati, Ohio. Catalogue SP-165, entitled "The Spiral Point—A New Era in Drilling," describing Cincinnati's new spiral point geometry for converting standard twist drills into precision tools. **517**

JIG BORING—Pratt & Whitney Co., Inc., West Hartford, Conn. Circular No. 614, presenting the company's end measure jig borers, made to deliver higher accuracy with greater speed and ease of operation. These machines have a wide range of spindle speeds and feeds. **518**

DIAL INDICATORS—Federal Products Corporation, Providence, R. I. Brochure describing the company's "Miracle Movement" dial indicator. The Miracle Movement is a new development which greatly extends operational life, providing substantially increased resistance to wear and shock. **519**

PLATING GENERATOR—National Carbon Co., New York, N. Y. Booklet CP-3004, a Brush Maintenance Manual for low-voltage generators containing practical tips on brush operation and maintenance on high-current, low-voltage generators used in electrolytic processes. **520**

AIR GAGES—Federal Products Corporation, Providence, R. I. 32-page catalogue No. 59D, describing the company's "Dimensionair" one-master air-gage system

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and providing specifications on two new air-gage models (10,000:1 and 20,000:1 magnification). 521

CHATTERLESS COUNTERSINKS—Madison-Relco Tool Co., Providence, R. I. Bulletin describing new type of adjustable countersink and explaining how patented bearing principle insures chatterless, safe operation regardless of feed or alignment. 522

CLUTCHES—Twin Disc Clutch Co., Racine, Wis. Bulletin 134-C, consisting of a 4-page engineering summary on the company's multiple-plate clutches for machine tool applications. Covered are Model MTS, a single-clutch, and Model MTU, a duplex unit built on a single hub. 523

BROACHES—California Broach Co., Los Angeles, Calif. Circular describing a line of twenty-eight portable broaches designed to economically solve exacting, high-production machining problems demanding maximum stock removal, and yet provide an extremely fine surface finish. 524

HANDSAWS—Atkins Saw Division, Borg-Warner Corporation, Indianapolis, Ind. Manual giving information on the design and construction of handsaws, basic types of saw teeth, and instructions on jointing, shaping, setting, and sharpening. 525

LATHES—Gisholt Machine Co., Madison, Wis. Booklet (Form 1213), covering the Gisholt Masterline No. 12, No. 12V, and No. 24 automatic production lathes. Each machine is completely illustrated showing machine features and accessories as well as floor plans and specifications. 526

WELDING CONTROL — Harnischfeger Corporation, Milwaukee, Wis. Bulletin entitled "Programmed Time-Amperage Control for Critical Welding," describing five units for the sequence timing of welds, including motorized rheostat controls and punched-tape programming. 527

LUBRICANT SELECTION—Alpha-Molykote Corporation, Stamford, Conn. Bulletin 121, featuring a Molykote lubricant selector chart which facilitates the choice of the proper lubricant for practically any extreme pressure lubrication job. 528

INSERTS—Lock Thread Corporation, Detroit, Mich. Folder describing the company's line of MIN.O.DEE inserts for repairing damaged threads and reinforcing light metals and plastic. 529

BENDING ROLL—Kling Bros. Engineering Works, Chicago, Ill. Catalogue describing the new horizontal, hydraulic double-pinch type angle and structural bending roll. 530

SURFACE PLATES—Herman Stone Co., Dayton, Ohio. Combination catalogue and price list Bulletin A, presenting information on granite surface plates and surface plate stands. 531

CHAIN DRIVES—Sun Oil Co., Industrial Products Department, Philadelphia, Pa. Bulletin entitled "Lubrication of Roller and Silent Chain Drives," covering principles of lubrication, maintenance, and oil selection. 532

MECHANICAL COUNTERS — Veeder-Root, Inc., Hartford, Conn. Catalogue presenting the company's high-speed electronic counters—standard mechanical and standard magnetic. 533

TORSION TESTING—Tinius Olsen Testing Machine Co., Willow Grove, Pa. Bulletin No. 58, describing the complete line of Olsen torsion testing machines. . .534

COLD-EXTRUDED PARTS—Burgess Norton Mfg. Co., Geneva, Ill. Bulletin treating the process of producing cold-extruded metal parts, their physical characteristics, etc. 535

ABRASIVES—Carborundum Co., Niagara Falls, N. Y. Folder featuring rubber-bonded abrasives for polishing and finishing such as rubber-bonded polishing wheels, unfinished sticks and stones, special-purpose stones, and wheel dressers and sticks. 536

COLD-PROCESSED ROD—Metals Division, Olin Mathieson Chemical Corporation, New York City. Brochure telling about Olin Aluminum cold-processed rod and screw-machine stock, as well as the "Stak-Pak" system for shipping, warehouse storing, and dispensing it. . .537

WHEELS FOR GRINDERS — Simonds Abrasive Co., Philadelphia, Pa. Bulletin (ESA-304) describing regular resinoid and vitrified bonded abrasive shagging wheels for portable grinding machine. 538

BEARINGS—Hoover Ball & Bearing Co., Ann Arbor, Mich. Bulletin No. 111, de-

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scribing double-row ball bearings—including open, shielded, and snap-ring types. 539

SPECIAL STEELS — Universal-Cyclops Steel Corporation, Bridgeville, Pa. Brochure covering "Unimach I" and "Unimach II" high-strength, high-temperature steels for critical structural applications in airborne vehicles. 540

MOTORS—General Electric Co., Schenectady, N. Y. Bulletin GEA-6882, discussing features and basic advantages of the new "unitized" motors. 541

DIE BASE—Wales-Strippit, Inc., Akron, N. Y. Catalogue describing a new type of die base for Strippit Type "CJ" hole punching units, which cuts replacement cost of round and shaped dies by approximately 50 per cent. 542

FASTENERS—Anti-Corrosive Metal Products Co., Inc., Castleton-on-Hudson, N. Y. 177-page combination reference handbook and catalogue presenting information on stainless-steel and nylon fasteners. 543

REDUCED-VOLTAGE STARTERS—General Electric Co., Schenectady, N. Y. Bulletin GEA-6860, telling when and where to use, and how to select G E reduced-voltage motor-starting equipment. ..544

TEMPLATES—Northwestern Tools, Inc., Dayton, Ohio. Brochure presenting a set of full-scale tracing templates designed for manufacturers of jigs, fixtures, and special machinery. 545

HORN PRESSES—Federal Machine & Welder Co., Warren, Ohio. Bulletin No. 52170A, illustrating and describing the Warco line of horn presses in capacities from 50 to 200 tons inclusive. 546

TUBING—Superior Tube Co., Morristown, Pa. Folder, (Data Memorandum No. 17), describing shaped tubing in square, rectangle, elliptical, oval, and a great variety of other cross-sections. 547

PRESSES—Minster Machine Co., Minster, Ohio. Bulletin discussing presses for automatic production of metal stampings, entitled "Minster Presses for Profitable Automatic Production." 548

ELECTRONIC CONTROL — Dynamatic Division, Eaton Mfg. Co., Kenosha, Wis. Bulletin No. K-2 describing its electronic control system, known as the "K-2 Control." 549

BAND SAW—Rockwell Mfg. Co., Delta Power Tool Division, Pittsburgh, Pa. Bulletin describing the recently introduced Delta 20-inch metal-wood cutting band saw. 550

PULLEYS—T. B. Wood's Sons Co., Chambersburg, Pa. Bulletin No. 4101 (revised), describing a line of variable-speed pulleys designed to eliminate freezing and sticking. 551

GRINDING WHEELS—The Carborundum Co., Niagara Falls, N. Y. Folder featuring "built-in guard" safety cup wheels for portable grinding in steel mills, foundries, and welding shops. 552

STRIP PLANT—Universal-Cyclops Steel Corporation, Bridgeville, Pa. Brochure describing the company's new plant and facilities at Coshocton, Ohio, for cold-finishing of stainless-steel strip. ..553

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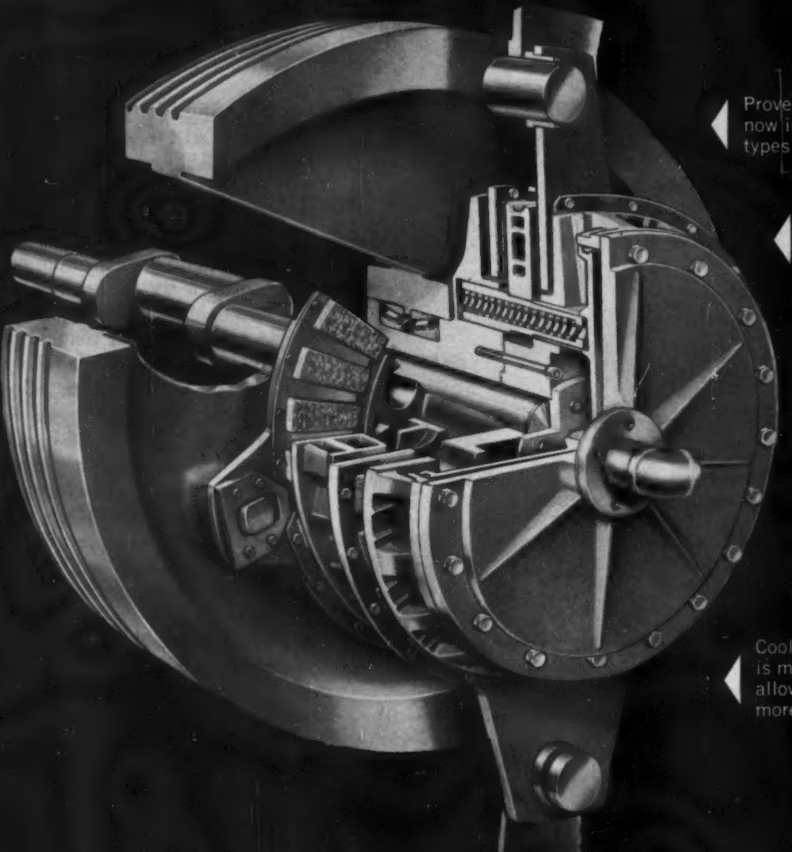

Proved design . . . hundreds now in daily use under all types of conditions.

Fast acting . . . only a fraction of inch movement between full clutch engagement and full brake.

Easy to service . . . with everything outside, clutch plates are easy to get at . . . easy to change . . . no disassembly required.

Self-aligning . . . discs "float" in mountings, align automatically. Plates also automatically compensate for wear — no adjustment needed.

Cool-running . . . everything is mounted on outside, allows heat to dissipate more rapidly.

New Bliss combination clutch and brake for inclinables...

RUNS COOLER UNDER TOUGH OPERATING CONDITIONS
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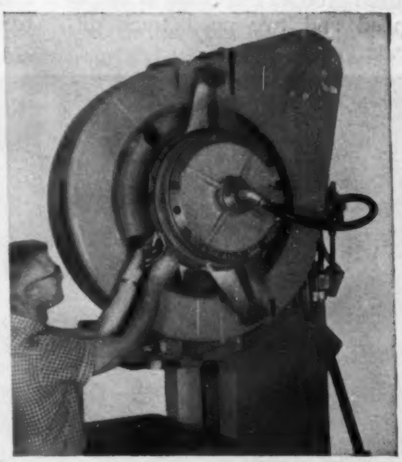

Here is a new combination clutch and brake that is rewriting the standards for inclinable press production.

It's an exceptionally fast operating clutch . . . one that licks the usual maintenance problems associated with high speed clutches.

Everything is mounted on the *outside* . . . the clutch is thus kept in open air *away* from the press frame . . . it dissipates heat far faster and there is no danger of bearing oil getting on the clutch plates — both factors that contribute to longer life.

An equally important feature is its universal top stopping. It practically eliminates the possibility of damaging dies through double-tripping; the new CK top stops every time; ram and feeds are always in synchronization.

Bliss' new CK clutch is designed for crankshaft mounting on flywheel inclinables and main gear mounting on geared inclinable presses. In either case, it runs faster *longer*. Why not get the complete facts on this important new development today?

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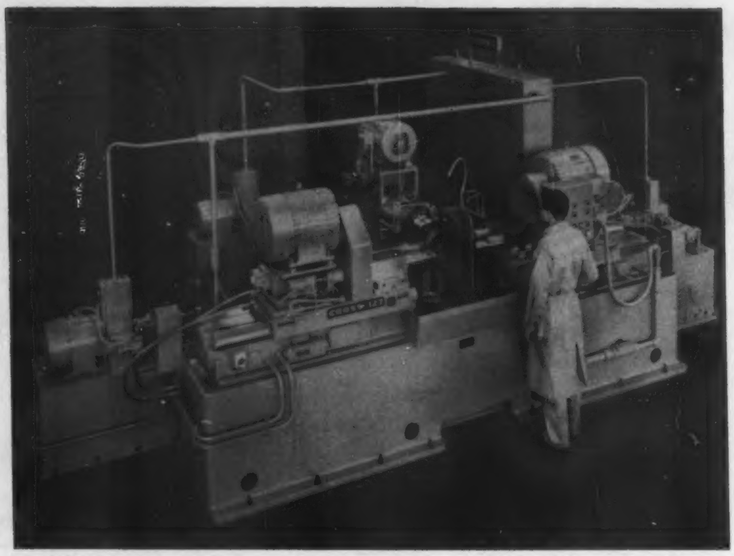


Fig. 1. One of three special three-way machines built by The Cross Co. to process truck differential carriers

Cross Automated Special Machines for Processing Truck Differential Carriers

Three automated special machines, developed to provide wide flexibility in precision machining a variety of parts with widely fluctuating output requirements, have been built by The Cross Co., Detroit, Mich. This unusual combination of three-way boring and facing machines is equipped for boring, facing, and grooving a mixed product consisting of single-speed and two-speed truck differential carriers. The three machines, each consisting of two double-spindle boring units and a cross-facing and boring unit, are shown here with typical setups.

The majority of the operations performed are in the high-precision class. For example, cross-shaft bores of two different diameters, required in the two-speed carriers only, Fig. 2, are held in a true plane within 0.0002 inch. A pilot bearing bore and pinion-cage pilot bore in the single-speed carrier, Fig. 3, are held square with the pinion mounting face within 0.0003 inch. In all of the operations performed on the various parts, a 50-micro-inch finish is obtained.

In spite of the accuracies called for, either the two-speed or the single-speed carriers may be produced on any or all three machines as output requirements dictate. This flexibility is made possible by the interchangeability of precision fabricated fixtures, tooling, and the ability to change machine unit locations in relation to the center line of the work station.

Normally, the two-speed carriers are the high-volume parts and are run off on two of the three machines at the rate of seventeen per hour on each machine. However, any combination of production schedules can be assigned the three machines. When, for example, the demand for one of the two-speed designs surpasses normal needs, one or both of the other machines may be switched over to process this part temporarily until production catches up with the demand. The primary advantage of this is to meet production requirements quickly at straight-time direct-cost rates.

Operations required on the high volume, two-speed carriers include finish-boring and grooving of the differential bores, finish-machining of the pinion bore and face, and finish-boring of two different diameter cross-shaft bores. The low-volume, single-speed carrier, usually produced on one of the three machines at a rate of twenty-four per hour, also requires two precision differential bores. Unlike the high-volume carriers, however, no snap-ring grooves are required on the differential bore surfaces of this part—a fact which accounts for the higher output rate. The only other operations required on this part include finish-machining of a pinion bore and face and a pilot bore. There are no cross-shaft bores on the single-speed carrier.

Differences between the two-speed carrier designs are in the location of the pinion and cross-shaft bores in relation to the center line of the differential bores.

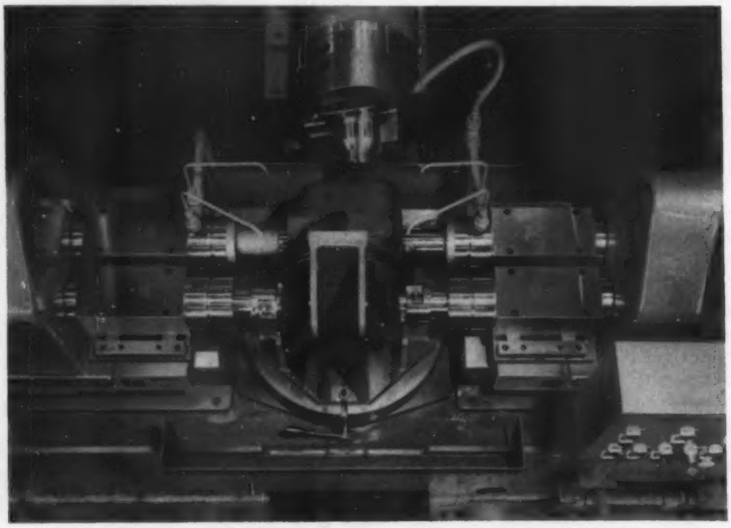


Fig. 2. Cross special machine setup for precision machining of two-speed truck differential carrier

Differences between the two-speed and single-speed designs, however, are major. The differential bores on this part occupy the same relative position as the cross-shaft bores on the two-speed carrier. Location of the pinion bore and face on the low-volume carrier, in relation to the center line of the work station, differs considerably from the high-volume case. In addition, an in-line pilot bore is required in this part. All three machines are designed and equipped to take care of these differences in the two-speed carrier as well as those in the single-speed design.

While the part is manually loaded and unloaded in the fixture between each cycle, the machining cycle is completely automatic with all units working on the part simultaneously. For ease in loading and unloading, the part is placed in the fixture in a position opposite to that in which it is machined, as shown in Fig. 3. When clamped in place, the operator indexes the part and fixture table 180 degrees until it is stopped and precision located by a shot pin. The table is locked in this position by a manually operated wedge clamp. Following the machining cycle, the table is again indexed 180 degrees to facilitate removal of the finished part.

Fig. 3. Special Cross machine with fixture table manually rotated to work-unloading position

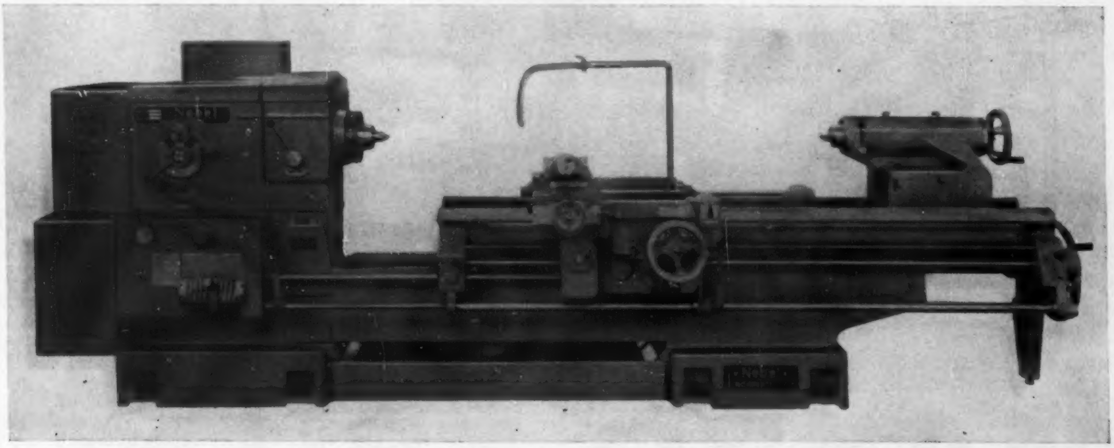
Circle Item 590 on postcard, page 195

Nebel Heavy-Duty Extension-Bed Gap Lathe

A double-purpose, heavy-duty extension-bed gap lathe, announced by the Nebel Machine Tool Corporation, Cincinnati, Ohio, can operate as a rugged engine lathe with a 26 1/2-inch swing over the bedways, or as a versatile gap lathe for large, odd-shaped parts, with a 46-inch swing through the gap. A 75 per cent increase in distance between centers is available by opening the gap. The distance is 48 inches with the gap closed and 84 inches with the gap open.

Eighteen gear-driven speeds are simply selected from a direct-reading color index, and easily controlled by two levers and color-keyed speed plates. Speeds up to 1500 rpm are available.

The quick-change gear-box provides sixty different feeds from 0.0027 to 0.192 inch and sixty changes for cutting threads from 1 to 72 threads per inch, including standard pipe threads. All feed and thread changes are selected from a direct-reading index-plate. Up to 20 hp is supplied by a constant-speed main-drive motor through a multiple-disc clutch and



Heavy-duty extension-bed gap lathe announced by the Nebel Machine Tool Corporation

brake mounted externally on the headstock to facilitate maintenance and adjustment. The upper bed is moved along the lower bed by means of a heavy screw located in the center of the bedways to assure accurate alignment. Traverse to the upper bed, for opening and closing the gap, is accomplished by power from the longitudinal feed mechanism, operated from either end of the bed, or manually through a handwheel.

The cross-slide support, extended to the front of the carriage, permits facing cuts to be taken for the full swing capacity through the gap without resetting the cross-slide.

A hardened cross-feed screw and a compound screw insure long life and accuracy, as does a compensating type anti-backlash cross-feed nut. The double-wall, one-piece cast apron provides inboard and outboard rigid bearing support for all rotating members. Heat-treated gears are designed for full load requirements and all shafts operate on anti-friction bearings. Two-way longitudinal power rapid traverse has an individual driving motor, mounted on the apron.

The heavy-duty tailstock, with its large-diameter spindle, can be moved under power from the longitudinal feed mechanism, if desired, by simply engaging the carriage through an interlock.

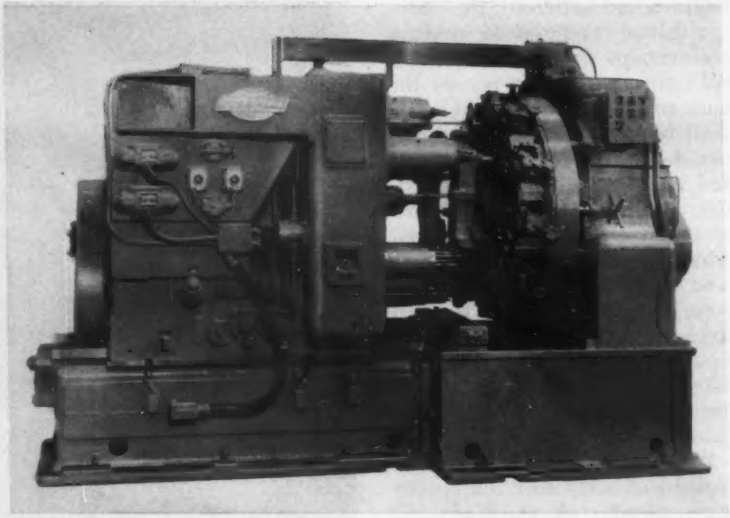


Fig. 1. Greenlee twelve-station special machine for processing oil-pump bodies

Automatic lubrication is provided for the headstock, quick-change gear-box, and apron. An externally mounted pump and motor supplies pressured lubrication to all headstock bearings, and automatic oil spray to all rotating parts. A cascade oil system supplies the quick-change gear-box, while end gearing is totally enclosed in a self-lubricating housing. All apron gears are lubricated from an oil reservoir. A one-shot system lubricates carriage ways, cross-slide, bedways, and other parts external to the apron.

Circle Item 591 on postcard, page 195

Greenlee Special Indexing Machines

Oil-pump bodies are being machined on a one-way, twelve-station, horizontal indexing machine built by Greenlee Bros. & Co., Rockford, Ill., at the rate of ninety-seven pieces per hour. Drilling, reaming, and boring operations are performed by this machine, Fig. 1, during a machining cycle of 37.2 seconds. Two clusters of reamers operate at accelerated feed rates. Hardened and ground steel ways, standard on all Greenlee special machines,

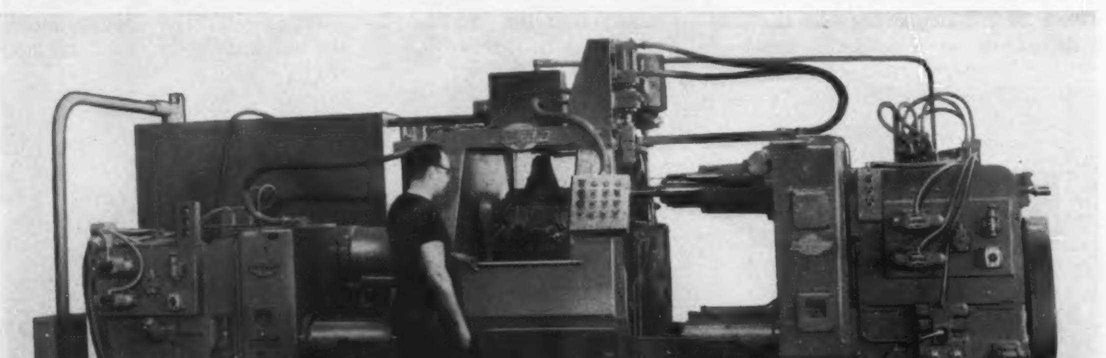
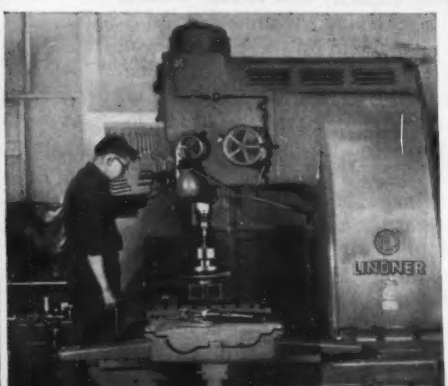


Fig. 2. Special two-way five-station Greenlee indexing machine that handles three different rear-axle housings

How the Lindner Jig Borer's Optical Measuring System reduces tooling costs

at F. J. Stokes



Lindner Model LB15A has 44" x 24" table with exclusive AUTOPOSITIONER® for pre-selecting initial and repeat table settings.

Production Jig Boring and Inspection at Stokes—51 holes, .750" diameter, 9" to 15" deep, in head of rotary tablet machine held to +.0005", —.0000" on Lindner Model LB15A. Holes are perpendicular to the base and parallel to each other within .0005".

"*Greater accuracy in jig boring* proved to be the key to more economical tooling," says Bill Kale, Chief Production Engineer at F. J. Stokes Corp., Philadelphia. "When we installed a Lindner, costs were substantially reduced."

How does the Lindner achieve this greater accuracy? Through a unique optical measuring system. Here's how it works:

There are no lead screws. No gage blocks. No bars or limit switches. The helically scribed, cylindrical measuring scales are touched by a light beam *only*. These scales are independent of the table movement mechanism and immovable in axial direction. Thus, the whole system is permanently protected against any mechanical wear whatever. Lifetime accuracy. And lifetime *economy!*

Says Mr. Kale: "Before installation of the Lindner, it was impossible to achieve such consistent accuracy. Manufacture of tooling and laying out complex jobs has now been greatly simplified. And the Lindner optical measuring system makes it possible for us to inspect the work *right in the machine*."

The Lindner optical measuring system is changing ideas about jig boring all over the country. We've packed all the facts into an informative 25-minute movie film. Send for it today without obligation, or write for literature.

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insure greater machine stability and accuracy.

Three different rear-axle housings are machined on the Greenlee two-way, five-station, horizontal indexing machine, Fig. 2. This machine produces ninety-four pieces per hour at 100 per cent efficiency. Two clusters of reamers operate at accelerated feed rates.

Circle Item 592 on postcard, page 195

Hannifin Alternate Bases

Two alternate bases, designed for greater piping versatility, are now available for the Series "CC" four-way directional air-control valves manufactured by the Hannifin Co., Des Plaines, Ill., a division of the Parker-Hannifin Corporation. The "Universal" base is normally used when combination piping and gasket mounting is desired. All eight ports are tapped for 1/4- or 3/8-inch pipe and the bottom ports also have O-ring groves for gasket mounting.

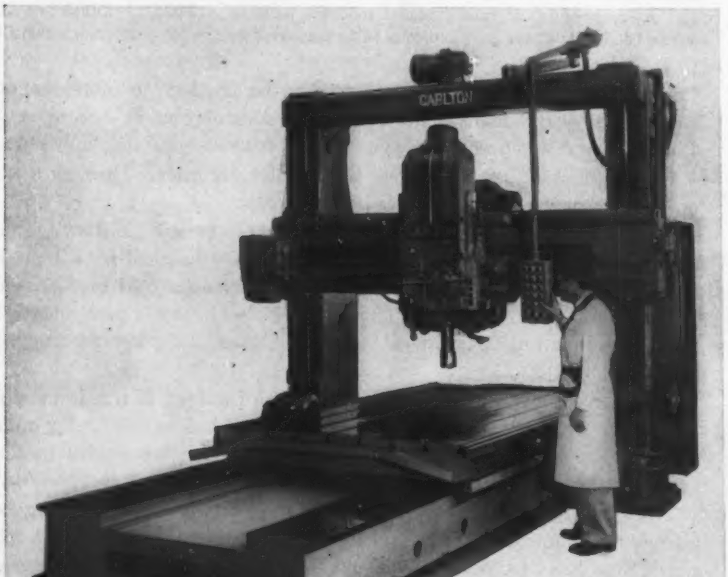
Hannifin alternate bases for four-way valves

Where only gasket mounting is required, the "Gasket Mounted" base is recommended. Bottom ports are O-ring grooved for mounting directly to the manifold or pad of a machine.

Circle Item 593 on postcard, page 195

Planer Type Drilling Machine with Large Automatic Positioning Table

A planer type drilling machine with an exceptionally large automatic positioning table has just been announced by the Carlton Machine Tool Co., Cincinnati, Ohio. The table is 72 inches wide and 126 inches long. Work-pieces can be accurately located for drilling, reaming, boring, tapping, and milling by any one of three methods: (1) pin-bar spacing; (2) vernier and rules; (3) numerical control (tape or manual).



Carlton planer type drilling machine with automatic positioning table

Numerical control permits positioning the table with an accuracy of plus or minus 0.0002 inch. When the tape control is furnished, positioning is through precision racks and pinions with read-out unit for locating the spindle (this is separate from the driving units for the table and head).

The pin-bar unit features pin-override control, allowing operator to override the pins without having to remove them from the bar. A 20-hp motor powers the drilling head which provides thirty-six spindle speeds and eighteen feeds. An alternating-current, constant-speed motor drive is provided for head and table travel. The rail and head are kept in alignment by means of tapered gibs.

The automatic positioning table is provided with precision-milled slots which enable an operator to locate work-pieces for machining operations quickly and accurately. The table operates on non-metallic ways which increase the load-carrying capacity and reduce friction to a minimum. An automatic lubrication system for the table, as well as for other areas of the machine, assures adequate lubrication at all times and helps to reduce maintenance to a minimum.

The table has a movement of 120 inches and is designed to traverse at the rate of 140 inches per minute with the head traversing at the rate of 100 inches per minute. The machine is controlled by a pendent type push-button station which allows the operator to work from either side of the table. This planer type drilling machine is well suited for use in machine shops or toolrooms where there is a variety of drilling, reaming, boring, tapping, and milling on short production runs, or even on single-piece work. The special positioning table and controls have been developed to eliminate the need for expensive tooling setups involving jigs and fixtures.

Circle Item 594 on postcard, page 195

(This section continued on page 212)

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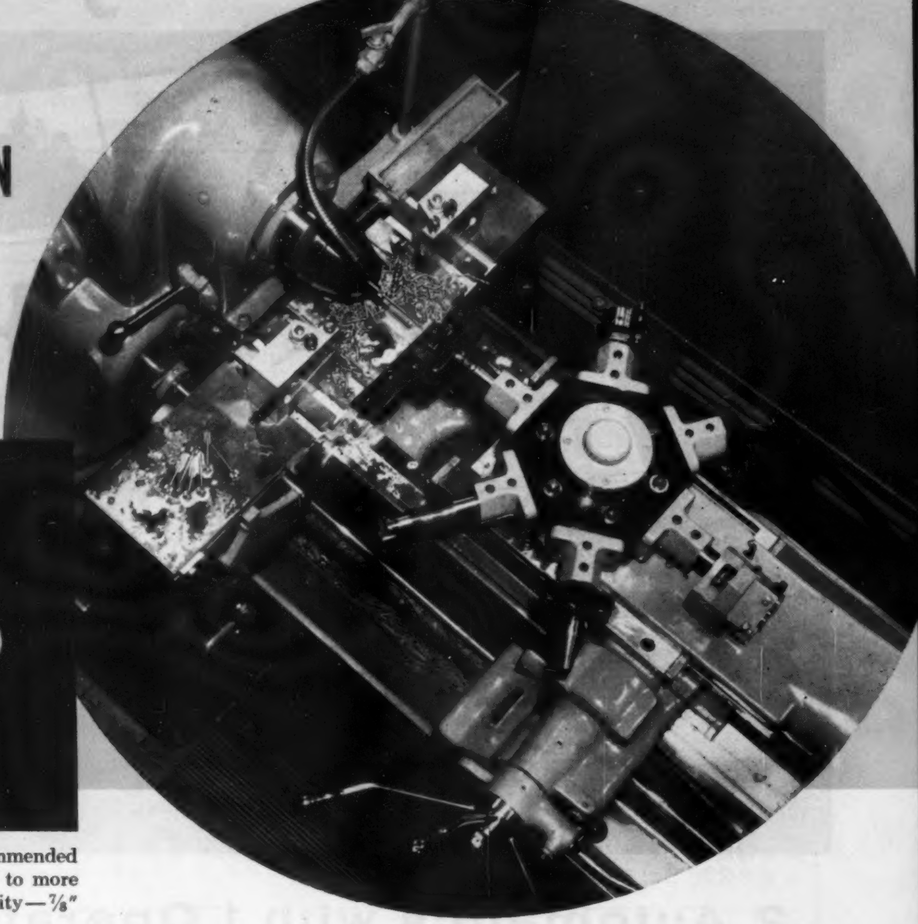
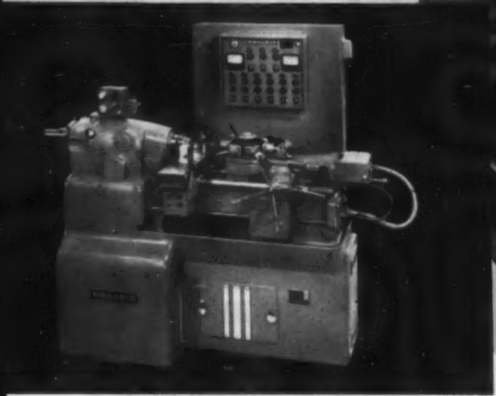
MONARCH HIGH PRODUCTION LATHES OF TOMORROW





The Model B Speedi-Matic—recommended for lots ranging from less than 25 to more than 2500 pieces. Bar stock capacity—⅞"

5. The New Model B Speedi-Matic... A Fast, Precision, Hand Screw Machine

Speed and accuracy of output have always typified the Monarch Speedi-Matic. Now with the latest developments in electronic speed control, a hydraulically powered turret and a host of other improvements, the 5 H.P. Model B is even better adapted to today's exacting requirements. Major features include:

(1) A control center that provides preselected, automatic speed and feed change for each tool position. Speed range is infinitely variable from 40 to 4000 R.P.M.; feed range, infinitely variable from ⅛" to 16" per minute. You get the most efficient speed and feed for each operation, consequently maximum production.

(2) A power feed, ram type turret, the turret head of which is hydraulically indexed, hydraulically located in the new position to an accuracy of less than .0002" and hydraulically clamped in position. It is also automatically lubricated.

(3) A feed box, powered by an electronically controlled feed motor.

(4) A powerful, lever operated, self-centering cut-off and forming slide that moves on preloaded ball bearings and carries its own forced feed lubrication system.

(5) Electrical controls to J.I.C. standards. The spindle and feed control elements are in the form of plug-in modules for ease of maintenance.

(6) Simplicity of setup to the degree that the time is regained during production of the first few pieces.

If one of your problems is the economical production of precision screw machine parts in small and medium size lots, then the Model B Speedi-Matic is for you. It will take only a few moments of your time to write for full information.

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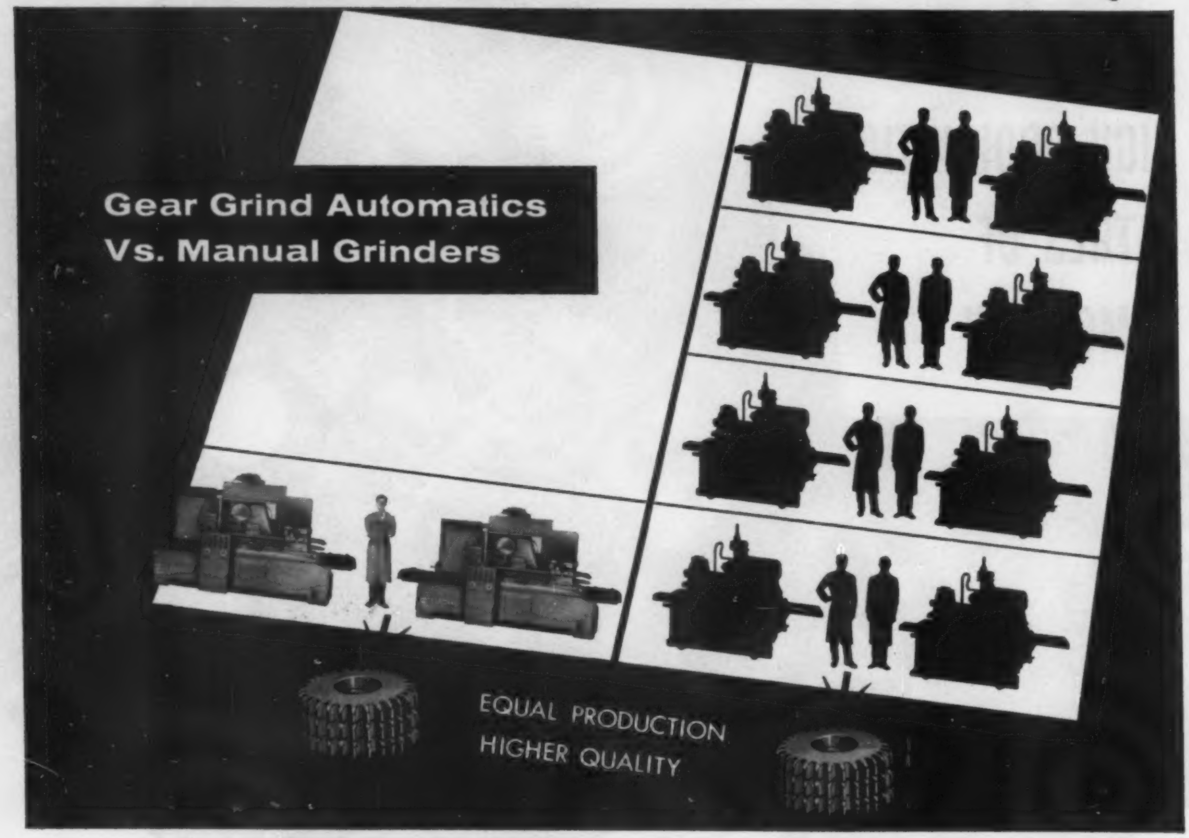

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0.000	0'00.0"	0' 3.6"	0' 7.2"	0'10.8"	0'14.4"	0'18"	0'21.6"	0'25.2"	0'28.8"	0'32.4"
0.010	0'36"	0'39.6"	0'43.2"	0'46.8"	0'50.4"	0'54"	0'57.6"	1' 1.2"	1' 4.8"	1' 8.4"
0.020	1'12"	1'15.6"	1'19.2"	1'22.8"	1'26.4"	1'30"	1'33.6"	1'37.2"	1'40.8"	1'44.4"
0.030	1'48"	1'51.6"	1'55.2"	1'58.8"	2' 2.4"	2' 6"	2' 9.6"	2'13.2"	2'16.8"	2'20.4"
0.040	2'24"	2'27.6"	2'31.2"	2'34.8"	2'38.4"	2'42"	2'45.6"	2'49.2"	2'52.8"	2'56.4"
0.050	3'00"	3' 3.6"	3' 7.2"	3'10.8"	3'14.4"	3'18"	3'21.6"	3'25.2"	3'28.8"	3'32.4"
0.060	3'36"	3'39.6"	3'43.2"	3'46.8"	3'50.4"	3'54"	3'57.6"	4' 1.2"	4' 4.8"	4' 8.4"
0.070	4'12"	4'15.6"	4'19.2"	4'22.8"	4'26.4"	4'30"	4'33.6"	4'37.2"	4'40.8"	4'44.4"
0.080	4'48"	4'51.6"	4'55.2"	4'58.8"	5' 2.4"	5' 6"	5' 9.6"	5'13.2"	5'16.8"	5'20.4"
0.090	5'24"	5'27.6"	5'31.2"	5'34.8"	5'38.4"	5'42"	5'45.6"	5'49.2"	5'52.8"	5'56.4"
0.100	6'00"	6' 3.6"	6' 7.2"	6'10.8"	6'14.4"	6'18"	6'21.6"	6'25.2"	6'28.8"	6'32.4"
0.110	6'36"	6'39.6"	6'43.2"	6'46.8"	6'50.4"	6'54"	6'57.6"	7' 1.2"	7' 4.8"	7' 8.4"
0.120	7'12"	7'15.6"	7'19.2"	7'22.8"	7'26.4"	7'30"	7'33.6"	7'37.2"	7'40.8"	7'44.4"
0.130	7'48"	7'51.6"	7'55.2"	7'58.8"	8' 2.4"	8' 6"	8' 9.6"	8'13.2"	8'16.8"	8'20.4"
0.140	8'24"	8'27.6"	8'31.2"	8'34.8"	8'38.4"	8'42"	8'45.6"	8'49.2"	8'52.8"	8'56.4"
0.150	9'00"	9' 3.6"	9' 7.2"	9'10.8"	9'14.4"	9'18"	9'21.6"	9'25.2"	9'28.8"	9'32.4"
0.160	9'36"	9'39.6"	9'43.2"	9'46.8"	9'50.4"	9'54"	9'57.6"	10' 1.2"	10' 4.8"	10' 8.4"
0.170	10'12"	10'15.6"	10'19.2"	10'22.8"	10'26.4"	10'30"	10'33.6"	10'37.2"	10'40.8"	10'44.4"
0.180	10'48"	10'51.6"	10'55.2"	10'58.8"	11' 2.4"	11' 6"	11' 9.6"	11'13.2"	11'16.8"	11'20.4"
0.190	11'24"	11'27.6"	11'31.2"	11'34.8"	11'38.4"	11'42"	11'45.6"	11'49.2"	11'52.8"	11'56.4"
0.200	12'00"	12' 3.6"	12' 7.2"	12'10.8"	12'14.4"	12'18"	12'21.6"	12'25.2"	12'28.8"	12'32.4"
0.210	12'36"	12'39.6"	12'43.2"	12'46.8"	12'50.4"	12'54"	12'57.6"	13' 1.2"	13' 4.8"	13' 8.4"
0.220	13'12"	13'15.6"	13'19.2"	13'22.8"	13'26.4"	13'30"	13'33.6"	13'37.2"	13'40.8"	13'44.4"
0.230	13'48"	13'51.6"	13'55.2"	13'58.8"	14' 2.4"	14' 6"	14' 9.6"	14'13.2"	14'16.8"	14'20.4"
0.240	14'24"	14'27.6"	14'31.2"	14'34.8"	14'38.4"	14'42"	14'45.6"	14'49.2"	14'52.8"	14'56.4"
0.250	15'00"	15' 3.6"	15' 7.2"	15'10.8"	15'14.4"	15'18"	15'21.6"	15'25.2"	15'28.8"	15'32.4"
0.260	15'36"	15'39.6"	15'43.2"	15'46.8"	15'50.4"	15'54"	15'57.6"	16' 1.2"	16' 4.8"	16' 8.4"
0.270	16'12"	16'15.6"	16'19.2"	16'22.8"	16'26.4"	16'30"	16'33.6"	16'37.2"	16'40.8"	16'44.4"
0.280	16'48"	16'51.6"	16'55.2"	16'58.8"	17' 2.4"	17' 6"	17' 9.6"	17'13.2"	17'16.8"	17'20.4"
0.290	17'24"	17'27.6"	17'31.2"	17'34.8"	17'38.4"	17'42"	17'45.6"	17'49.2"	17'52.8"	17'56.4"
0.300	18'00"	18' 3.6"	18' 7.2"	18'10.8"	18'14.4"	18'18"	18'21.6"	18'25.2"	18'28.8"	18'32.4"
0.310	18'36"	18'39.6"	18'43.2"	18'46.8"	18'50.4"	18'54"	18'57.6"	19' 1.2"	19' 4.8"	19' 8.4"
0.320	19'12"	19'15.6"	19'19.2"	19'22.8"	19'26.4"	19'30"	19'33.6"	19'37.2"	19'40.8"	19'44.4"
0.330	19'48"	19'51.6"	19'55.2"	19'58.8"	20' 2.4"	20' 6"	20' 9.6"	20'13.2"	20'16.8"	20'20.4"
0.340	20'24"	20'27.6"	20'31.2"	20'34.8"	20'38.4"	20'42"	20'45.6"	20'49.2"	20'52.8"	20'56.4"
0.350	21'00"	21' 3.6"	21' 7.2"	21'10.8"	21'14.4"	21'18"	21'21.6"	21'25.2"	21'28.8"	21'32.4"

Compiled by D. E. Lewis, Devon, England

TABLE FOR CONVERTING DECIMALS OF A DEGREE INTO MINUTES AND SECONDS—2

Decimal of Degree	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
0.360	21'36"	21'39.6"	21'43.2"	21'46.8"	21'50.4"	21'54"	21'57.6"	22' 1.2"	22' 4.8"	22' 8.4"
0.370	22'12"	22'15.6"	22'19.2"	22'22.8"	22'26.4"	22'30"	22'33.6"	22'37.2"	22'40.8"	22'44.4"
0.380	22'48"	22'51.6"	22'55.2"	22'58.8"	23' 2.4"	23' 6"	23' 9.6"	23'13.2"	23'16.8"	23'20.4"
0.390	23'24"	23'27.6"	23'31.2"	23'34.8"	23'38.4"	23'42"	23'45.6"	23'49.2"	23'52.8"	23'56.4"
0.400	24' 0"	24' 3.6"	24' 7.2"	24'10.8"	24'14.4"	24'18"	24'21.6"	24'25.2"	24'28.8"	24'32.4"
0.410	24'36"	24'39.6"	24'43.2"	24'46.8"	24'50.4"	24'54"	24'57.6"	25' 1.2"	25' 4.8"	25' 8.4"
0.420	25'12"	25'15.6"	25'19.2"	25'22.8"	25'26.4"	25'30"	25'33.6"	25'37.2"	25'40.8"	25'44.4"
0.430	25'48"	25'51.6"	25'55.2"	25'58.8"	26' 2.4"	26' 6"	26' 9.6"	26'13.2"	26'16.8"	26'20.4"
0.440	26'24"	26'27.6"	26'31.2"	26'34.8"	26'38.4"	26'42"	26'45.6"	26'49.2"	26'52.8"	26'56.4"
0.450	27' 0"	27' 3.6"	27' 7.2"	27'10.8"	27'14.4"	27'18"	27'21.6"	27'25.2"	27'28.8"	27'32.4"
0.460	27'36"	27'39.6"	27'43.2"	27'46.8"	27'50.4"	27'54"	27'57.6"	28' 1.2"	28' 4.8"	28' 8.4"
0.470	28'12"	28'15.6"	28'19.2"	28'22.8"	28'26.4"	28'30"	28'33.6"	28'37.2"	28'40.8"	28'44.4"
0.480	28'48"	28'51.6"	28'55.2"	28'58.8"	29' 2.4"	29' 6"	29' 9.6"	29'13.2"	29'16.8"	29'20.4"
0.490	29'24"	29'27.6"	29'31.2"	29'34.8"	29'38.4"	29'42"	29'45.6"	29'49.2"	29'52.8"	29'56.4"
0.500	30' 0"	30' 3.6"	30' 7.2"	30'10.8"	30'14.4"	30'18"	30'21.6"	30'25.2"	30'28.8"	30'32.4"
0.510	30'36"	30'39.6"	30'43.2"	30'46.8"	30'50.4"	30'54"	30'57.6"	31' 1.2"	31' 4.8"	31' 8.4"
0.520	31'12"	31'15.6"	31'19.2"	31'22.8"	31'26.4"	31'30"	31'33.6"	31'37.2"	31'40.8"	31'44.4"
0.530	31'48"	31'51.6"	31'55.2"	31'58.8"	32' 2.4"	32' 6"	32' 9.6"	32'13.2"	32'16.8"	32'20.4"
0.540	32'24"	32'27.6"	32'31.2"	32'34.8"	32'38.4"	32'42"	32'45.6"	32'49.2"	32'52.8"	32'56.4"
0.550	33' 0"	33' 3.6"	33' 7.2"	33'10.8"	33'14.4"	33'18"	33'21.6"	33'25.2"	33'28.8"	33'32.4"
0.560	33'36"	33'39.6"	33'43.2"	33'46.8"	33'50.4"	33'54"	33'57.6"	34' 1.2"	34' 4.8"	34' 8.4"
0.570	34'12"	34'15.6"	34'19.2"	34'22.8"	34'26.4"	34'30"	34'33.6"	34'37.2"	34'40.8"	34'44.4"
0.580	34'48"	34'51.6"	34'55.2"	34'58.8"	35' 2.4"	35' 6"	35' 9.6"	35'13.2"	35'16.8"	35'20.4"
0.590	35'24"	35'27.6"	35'31.2"	35'34.8"	35'38.4"	35'42"	35'45.6"	35'49.2"	35'52.8"	35'56.4"
0.600	36' 0"	36' 3.6"	36' 7.2"	36'10.8"	36'14.4"	36'18"	36'21.6"	36'25.2"	36'28.8"	36'32.4"
0.610	36'36"	36'39.6"	36'43.2"	36'46.8"	36'50.4"	36'54"	36'57.6"	37' 1.2"	37' 4.8"	37' 8.4"
0.620	37'12"	37'15.6"	37'19.2"	37'22.8"	37'26.4"	37'30"	37'33.6"	37'37.2"	37'40.8"	37'44.4"
0.630	37'48"	37'51.6"	37'55.2"	37'58.8"	38' 2.4"	38' 6"	38' 9.6"	38'13.2"	38'16.8"	38'20.4"
0.640	38'24"	38'27.6"	38'31.2"	38'34.8"	38'38.4"	38'42"	38'45.6"	38'49.2"	38'52.8"	38'56.4"
0.650	39' 0"	39' 3.6"	39' 7.2"	39'10.8"	39'14.4"	39'18"	39'21.6"	39'25.2"	39'28.8"	39'32.4"
0.660	39'36"	39'39.6"	39'43.2"	39'46.8"	39'50.4"	39'54"	39'57.6"	40' 1.2"	40' 4.8"	40' 8.4"
0.670	40'12"	40'15.6"	40'19.2"	40'22.8"	40'26.4"	40'30"	40'33.6"	40'37.2"	40'40.8"	40'44.4"
0.680	40'48"	40'51.6"	40'55.2"	40'58.8"	41' 2.4"	41' 6"	41' 9.6"	41'13.2"	41'16.8"	41'20.4"
0.690	41'24"	41'27.6"	41'31.2"	41'34.8"	41'38.4"	41'42"	41'45.6"	41'49.2"	41'52.8"	41'56.4"
0.700	42' 0"	42' 3.6"	42' 7.2"	42'10.8"	42'14.4"	42'18"	42'21.6"	42'25.2"	42'28.8"	42'32.4"

Note: Continued in MACHINERY'S Data Sheet for October, 1959

Compiled by D. E. Lewis, Devon, England


CAPEWELL
announces
L-100-M SPEED-BAND
a new concept in band saw blades
CAPEWELL L-100-M
SPEED-BAND
DOUBLE CARBIDE PAT. PEND.
From Capewell's famous Research and Development Laboratory comes the announcement of an important new metalworking development—Speed-Band
Speed-Band is the first band saw blade to be produced from a new alloy specifically designed for band saw blades
Speed-Band is made from a double carbide alloy formulated to deliver optimum performance by embodying those characteristics most needed for economic sawing
Speed-Band's double carbide alloy provides the hot hardness and abrasion resistance which permit use at higher speeds and feeds on *standard* carbon band saw machines
Speed-Band's hot hardness and abrasion resistance increases the range and types of materials which can be cut on standard carbon band saw cutoff machines
Speed-Band's hot hardness and abrasion resistance qualities guarantee faster cutting and greater productivity
Speed-Band's exclusive features greatly extend blade life, reduce blade changing and down time, and minimize tool risk.
Speed-Band is the first band saw ever to be designed and developed with the user and the end use in mind. The genuine Speed-Band is manufactured only by the Capewell Mfg. Co., and sold only through authorized Capewell Distributors.
INDUSTRIAL DISTRIBUTORS
SERVING INDUSTRY ECONOMICALLY
THE RIGHT HAND OF PRODUCTION
THE CAPEWELL MFG. CO., HARTFORD 2, CONN.
Special note to buyers of capital equipment:
Speed-Band's greater potential on standard equipment can eliminate the need for expensive special machinery.
Speed-Band's increased performance potential allows standard carbon bandsaw machines to be operated to their full capability for the first time.
Speed-Band's flexibility permits its use on machines designed for high speed bands, and where applicable, can reduce tool cost substantially.
Before you buy, see your Capewell Distributor for all the details on Speed-Band, the sensible band saw.

Get new-forging performance at 1/3 the cost from ERIE FOUNDRY REBUILDING SERVICE

Here at the Erie Foundry Rebuilding "Hospital", we disassemble and inspect your forging hammer, remachine worn surfaces, true bearings, replace broken parts, repair cracked parts. Once the hammer is reassembled, tested and put back in operation, it'll be as spry and sound as a new machine—but at one-third the cost!

Stands to reason that the leaders in forge manufacture for over 60 years should be the best source for forge repair.

Regardless of who made it, or how badly it's cracked, broken or worn, your forging hammer will recover most quickly at Erie Foundry's Rebuilding "Hospital". Write for the complete story.

ERIE

THE WORLD'S GREATEST NAME IN FORGING SINCE 1895

ERIE FOUNDRY CO.
ERIE 5, PA.

EF-59-02

ARE YOU READY WITH THE ANSWERS

Threadwell
MAKES THE BEST PRODUCT BETTER

INDUSTRIAL DISTRIBUTORS
SERVING INDUSTRY ECONOMICALLY
THE RIGHT HAND OF PRODUCTION

Threadwell Field Men and Distributors Can Help You in Production Planning

When your next order involves multiple or complicated machining operations, and you've got your processing and production equipment all lined up, make sure you insure your investment by putting Threadwell cutting tools in those holders. They'll provide the uninterrupted high quality production all your machine tools are designed for.

Before pushing those buttons, check with your Threadwell Distributor. His experience and advice costs you nothing

THREADWELL TAP & DIE CO.
GREENFIELD, MASSACHUSETTS

Stocking Warehouses: New York — Cleveland Detroit — Los Angeles — Greenfield, Mass.

For more data, circle this page number on inquiry card

"Boreking" Boring, Turning, and Facing Machine

A twin-spindle, precision boring, turning, and facing machine, designated the "Boreking," has been added to the line of "Unimatic" boring machines made by the Atlantic Instrument Corporation and sold by Russell, Holbrook & Henderson, Inc., New York City. The new unit is designed to perform a complete precision finishing operation on a blank in one automatic cycle. While the front of the piece is being finished on one spindle, the reverse side may be machined on the other spindle. With proper tooling, it is possible to perform multiple operations such as boring, facing, and turning. The automatic cycle of the machine can be set for any combination of feeds with fast approaches and returns where applicable.

The main table slides on two round, hardened and ground ways, protected by accordion-pleated boots. The head and bed are scraped and fitted to a granite base of high permanency and lapped to a flatness of 0.00005 inch. This machine is capable of duplicating work to a tolerance of less than 0.0002 inch on a face cut and 0.00005 inch on a bore.

The two air-motor units allow for independent adjustments of the main table and cross-slide feed. Spindle speeds are infinitely variable between 400 and 4000 rpm, and can be set independently for each spindle. The drive is from a single 3/4-hp motor with a variable-speed drive. The compact unit, mounted on a welded steel cabinet with a tool-storage compartment, requires a floor space 28 by 52 inches.

Circle Item 595 on postcard, page 195

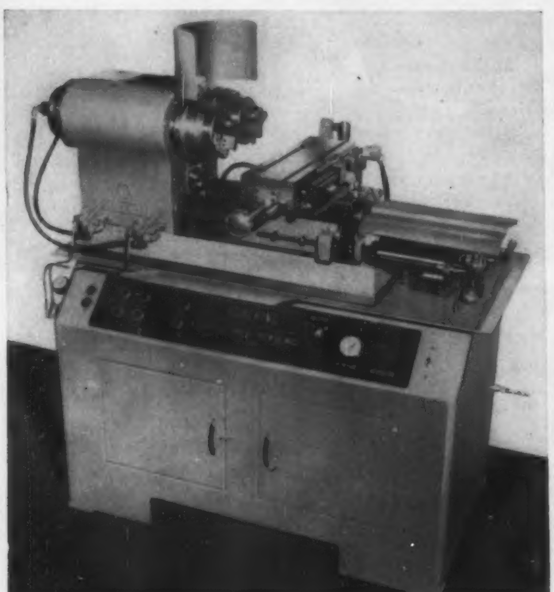
Aircomatic Machine-Welding Equipment

Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City, has added several items to its line of Aircomatic machine-welding equipment for use with its gas-shielded metal-arc process. These additions include: two Aircomatic heads, Models AMH-D and AMH-E; two controls, Models AMC-C and AMC-D; and two machine barrels, Models AM80-A and AM80-B.

Designed for maximum versatility, various combinations of these machine heads, controls, and barrels, can be used to suit the needs of individual jobs. The Aircomatic heads are single-motor-driven units, primarily intended for use with CAV and RAV power sources using ferrous and non-ferrous aluminum and hard wires from 0.030 to 1/8 inch in diameter. They can also be employed with conventional direct-current power sources when ferrous wires only are used. The units are equipped with thyratron-controlled direct-current motors which have constant wire-feed speeds up to 600 inches per minute for Model AMH-E and 1000 inches per minute for Model AMH-D. The heads can be used with argon, helium, mixtures of both, or carbon dioxide (CO_2) as the shielding gas.

Two control units are available for use with these heads. Model AMC-C is a standard unit complete with crater filler, meters, push-buttons, gas, and water solenoids. It operates on 230 volts, single-phase, 60-cycle current. The Model AMC-D is designed to be used by fixture builders who are considering a common control panel for all electrical equipment. Operating on 115 volts, single-phase, 60-cycle current, it can be adapted to a wide range of work.

Both machine barrels used with this equipment are rated at 800

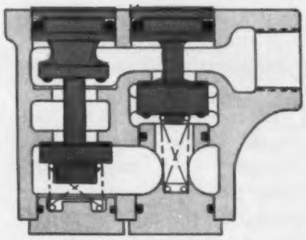


"Boreking" automatic-cycling boring, turning, and facing machine

Machine-welding equipment announced by Air Reduction Sales Co.

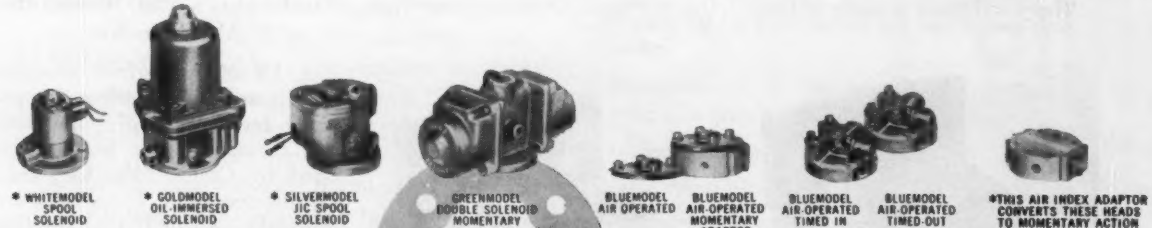
a basic Ross valve building block

4-way inline mounted valve body



- **Compact—saves space** • **Ross quality**
- **Costs much less than base mounted 4-way**

Lots of designers use this valve where they must save space. It was designed specifically for compactness! Others use it to save money *without sacrificing* quality—when J.I.C. allows the usage of an inline valve, it meets J.I.C. specs. It's a unit of the Ross Skyline series which features modular construction, so it can be actuated with any Skyline series head. Ross poppet construction means pressure assists the seal, and short poppet travel gives faster response. On most applications it outlives the machine—and frequently doesn't even require maintenance. Write for Bulletin 321.



"every head meets every body at this gasket"

ALL SKYLINE HEADS AND BODIES ARE BUILDING BLOCKS TO GIVE YOU MANY VALVES FROM A FEW HEADS AND BODIES

STAY AHEAD

MODERNIZE

ROSS OPERATING VALVE COMPANY

110 EAST GOLDEN GATE AVE. • DETROIT 3, MICH.

For more data, circle this page number on inquiry card

amperes direct-current, continuous-duty cycle. Model AM80-A is a water-cooled unit with concentric shielding for all applications, while Model AM80-B is an air-cooled unit with an external shield for high-production CO_2 applications using hard wire only. The equipment is said to have broad applications in the automotive and associated industries, and may be adapted for Aircomatic machine cutting.

Circle Item 596 on postcard, page 195

B & S Tool Chests

The Brown & Sharpe Mfg. Co., Providence, R. I., has introduced a complete line of machinists' tool chests. Made of wood or metal, they are furnished with three different assortments of tools which have been selected to meet the needs of toolmakers, machinists, and apprentices in the metalworking field. The largest assortment contains twenty-one tools; the medium assortment, seventeen tools; and the smallest assortment, eleven tools.

The chests have drawers of several depths and widths, as shown in the illustration, to accommodate the original assortment of tools with ample room for additional tools which might be purchased later. Each is so designed that, when the cover is in its closed position, the entire chest can be locked.

The wood chest is made of fine-quality oak, generally preferred by experienced toolmakers.

The metal chest is similar in size and drawer arrangement but has a smooth, hard, baked blue finish which is very durable and easy to keep clean. The corners are rounded and will not catch or tear clothing. The drawers have safety stops to prevent their sliding out.

Circle Item 597 on postcard, page 195

Machinists' tool chests brought out by the Brown & Sharpe Mfg. Co.

New Equipment for Strippit Fabricators

Wales-Strippit, Inc., Akron, N. Y., has developed a Microbar gaging assembly and a toggle-switch control mechanism to increase the convenience and efficiency of their high-speed, quick-change punch presses or fabricators. The Microbar assembly, mounted on the pantographic duplicator attachment of the Fabricator, makes it possible to produce templates or single production pieces to extremely close tolerance. The assembly consists of one machined bar that bridges the Duplicator carriage and another mounted on the work-table. Both bars are precision drilled and bushed at 1-inch intervals, with dial indicators to provide forward, backward, and lateral settings to the nearest thousandth of an inch.

Stops placed in the bushed holes in both Microbars contact each dial indicator arm to provide the readings. Operation involves merely placing the stops to the nearest inch as specified on the layout or drawing, then adjusting the carriage to obtain the desired reading in thousandths, and locking the carriage in position. This automatically positions the work.

Strippit Microbar gaging unit applied to punch press

The toggle-switch mechanism cuts change-over time between template punching and production punching with the Strippit Fabricator-Duplicator.

All Fabricator-Duplicators are now supplied with an outlet box with disconnect receptacles, the toggle switch, and a built-in receptacle for the 110-volt power supply to the Dupl-O-Scope transformer. The Duplicator, the Microbar assembly, and the Dupl-O-Scope four-power optical scanner are available with the basic Strippit Fabricator punch press for punching and notching up to 1/4-inch-thick mild steel.

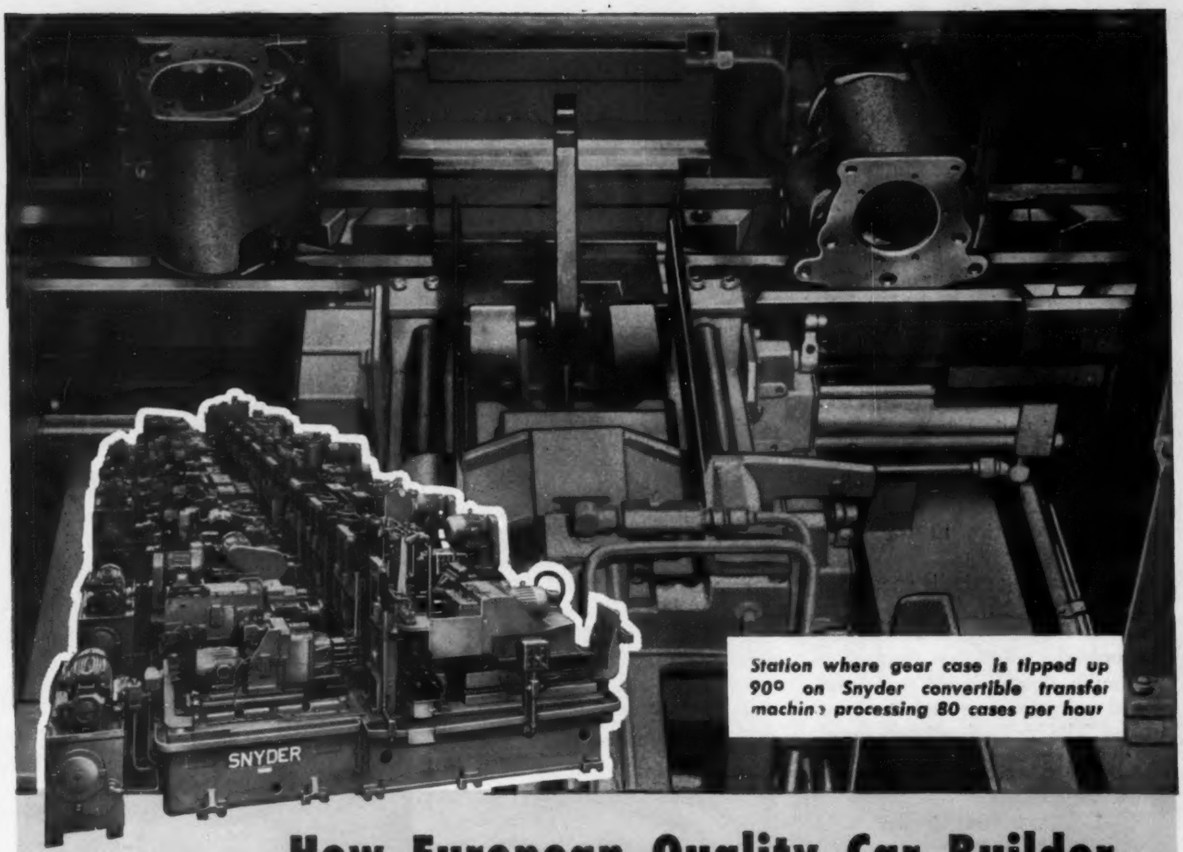
Circle Item 598 on postcard, page 195

Toolmakers' and Diemakers' Abrasive Kit

A kit of rubberized abrasive wheels and points, selected especially for the use of toolmakers and diemakers, has been developed by Cratex Mfg. Co., Inc., Burlingame, Calif. These tools are especially adapted for sensitive deburring, smoothing, and polishing. The kit has eighty wheels and points selected from three hundred fifty available shapes as being the most useful in the manufacture of tools, dies, molds, and component parts. They are equally assorted in four grit textures (coarse-C, medium-M, fine-F, and extra fine-XF). In the set there are also four mandrels for a 1/8-inch chuck.

Circle Item 599 on postcard, page 195

(This section continued on page 216)



Station where gear case is tipped up 90° on Snyder convertible transfer machine processing 80 cases per hour

How European Quality Car Builder Snyderizes for the Soaring Sixties

This new 53-station transfer machine combines special purpose efficiency with high convertibility for later changes. Part orienting devices enable Snyder to utilize standard horizontal way-type units to drill, spotface, chamfer, ream, line-ream, mill and bore this cast iron standard gear transmission case on all faces. The cases are turned 90° at the thirteenth station and tipped up 90° at the thirty-eighth station, which eliminates vertical machining units. The part is specifically located on faces not subject to future design changes, thus reducing future capital expenditure.

* * *

Let us show *you* how to SNYDERIZE FOR THE SOARING SIXTIES for more efficient parts handling, gaging, assembly and machining. Send or phone for new brochure with resume of Snyder machines engineered for profit improvement.

Standard Features of Snyder Machines

1. SNYDER SELF-CONTAINED UNITS and other units equipped with hardened and ground steel ways.
2. Threading and tap heads equipped with individual lead-screw spindles.
3. Minimum downtime for tool changes because spindles are arranged for pre-set cutting tools.
4. Automatic lubrication.
5. J.I.C. Standards throughout.
6. Electrical interlocks and full depth circuit throughout.
7. Panels equipped with SNYDER CIRCUIT SLEUTH.

SNYDER CORPORATION

(Formerly Snyder Tool & Engineering Company)

3400 E. LAFAYETTE—DETROIT 7, MICHIGAN
Phone: LO 7-0123

For more data, circle this page number on inquiry card

Bokoe Flow-Forming and Spinning Lathes

The Cosa Corporation, New York City, is introducing in this country a D-35 series of Bokoe spinning and flow-forming lathes. The series covers the need of practically any production requirement, beginning with a basic hand-operated machine and culminating in the "Hycoform." This latter model is a heavy-duty, hydraulic, semi-automatic copying machine, designed to mass-produce nose cones as well as cylindrical and tapered parts. The "Hycoform" is the ultimate in the D-35 series of spinning lathes. It is constructed on the "building block" system with the addition of various accessories to the basic machine.

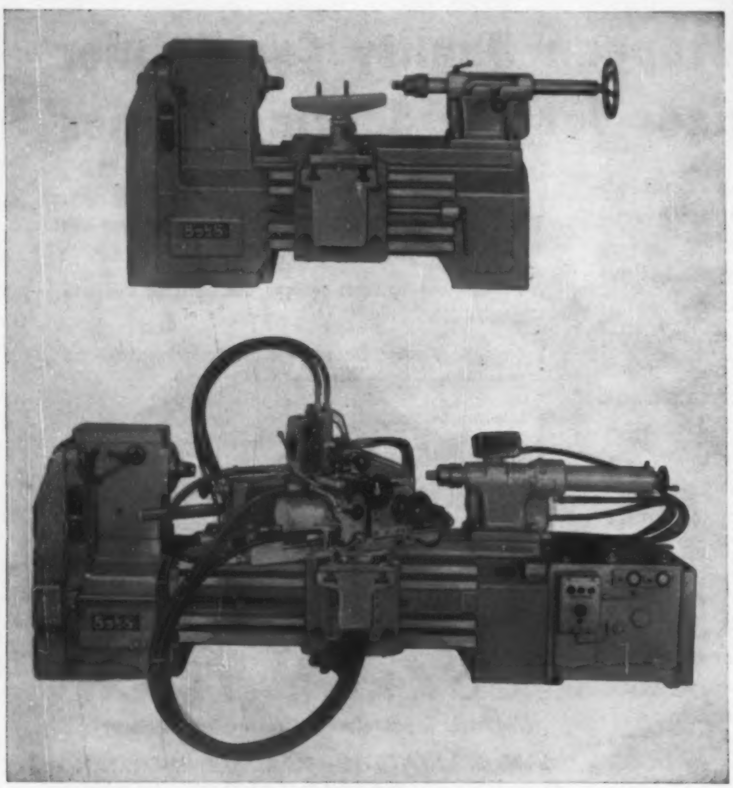
The operating spindle speeds, at constant output, cover the range from 45 to 1200 rpm. The speed is steplessly adjustable through a hydraulic drive. Start, stop, and speed selection are remote controlled. The hydraulically operated transverse and longitudinal slides are mounted on a rotary base. Patented slideways and gib design, having two carrying surfaces at right angles to each other, assure positive guidance regardless of forming pressures. For mass production, a built-in program control is available.

Provisions have been made to increase versatility by adding a second saddle at the rear of the machine. The saddle has cross-slides on a rotary base with attachments for forming complex parts.

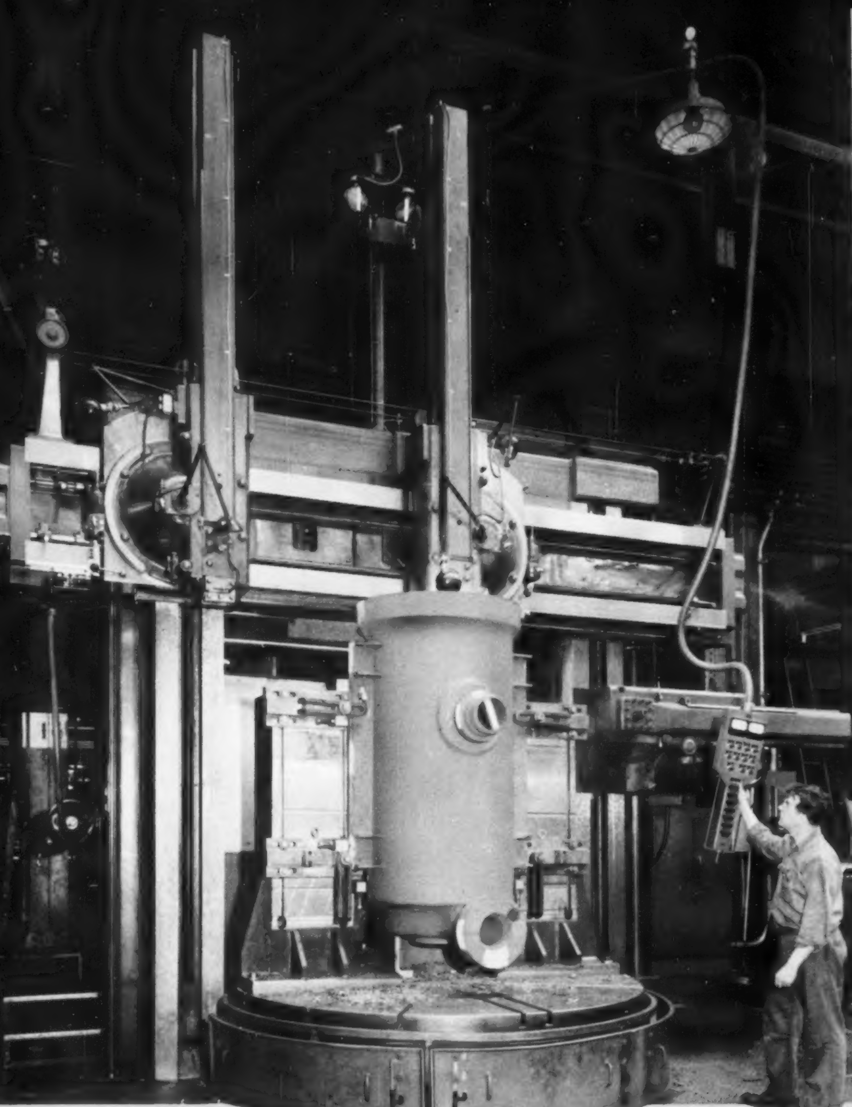
This equipment will flow-form aluminum up to 3/8 inch in thickness and steel up to 1/4 inch thick. Maximum swing is 28 inches, and longitudinal slide travel, 16 inches. Cross-slide travel is 6 inches, and center distance, 42 inches. The main drive consists of a 7.5-hp motor.

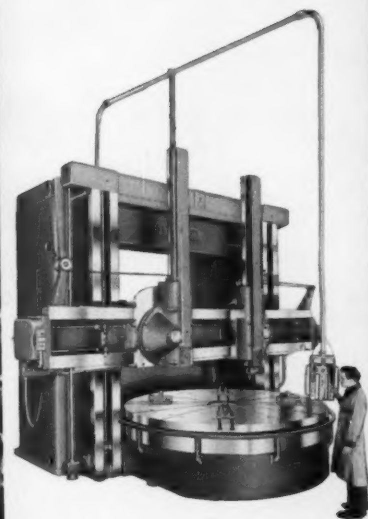
Circle Item 600 on postcard, page 195

(This section continued on page 220)



(Upper view) Bokoe basic hand-spinning lathe and (lower view) "Hycoform" automatic introduced by Cosa Corporation





Standard sizes
54-inch through 20-foot

Photo courtesy Allis Chalmers Manufacturing Co., West Allis, Wisconsin

low friction · high finish

Stuart's **CODOL**

liquid grinding compound

Grinding experts will tell you there's only one way to get a slick surface finish without going to extremely fine grit wheels or a straight grinding oil—and you don't have to give up wheel life or cooling action to get it.

That is by utilizing the balanced lubricating and scrubbing action of a water-mix like Stuart's Codol liquid grinding compound. For Codol's balanced formula provides the high surface finish advantages of a straight oil . . . in colloidal form . . . plus the cooling capacity of water.

Extremely fine oil particle size results in a near-transparent solution. Codol is not an opaque emulsion like most soluble oils . . . yet, it has none of the machine maintenance disadvantages of transparent compounds.

Use Codol for fine-finish grinding when you want to keep wheel inventory costs at a minimum and production efficiency right at peak.

Read on the opposite page how Codol helped solve a tough finish problem at International Business Machines Corp.

Stuart

Stuart's Codol combines lubricity with detergency, for fine-finish grinding

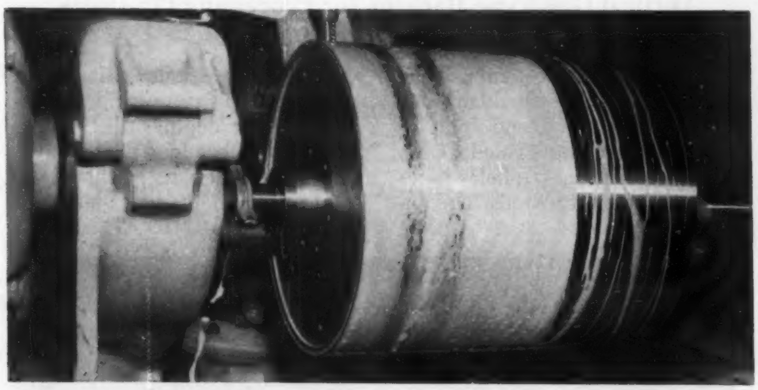
Extremely fine oil particles in Codol serve to reduce the clearance between wheel grits and make a grinding wheel act softer.

Standard wheels grind like fine-grit wheels—produce mirror finishes that cannot be duplicated if you rely strictly on grit action. Thus, greater wheel versatility reduces your inventory costs and simplifies wheel stocking problems. But, real benefits come from improved performance of the machine and wheel . . . as well as from improved product quality.

Codol keeps a wheel open and free-cutting. It's a real detergent. You don't have to worry about heat-stressing. ▼

Stuart's straight grinding oils and new, highly detergent, petrochemical solution, Hi-D—your Stuart representative can provide the grinding fluid best suited to your particular work.

Proof of performance—*At International Business Machines Corp., the problem for Codol was preparing the plating surface on 10 in. OD "memory units" (below) used in data-processing equipment. To produce a surface free of roughness or dimensional inaccuracy, the monel drums are precision ground, removing .008 in. stock and holding concentricity within .00025 in. Stuart's Codol provides the lubricity and high detergency required for producing a smooth, mirror-like finish, plus the cooling capacity required for accurate stress-free grinding. After grinding, the drums are copper-plated and turned with a diamond point.*



Yet, Codol will not remove way lubricant or attack the finish of machine tools. This adds up to fine finishes, good wheel life, less downtime for dressing wheels, and lower machine maintenance.

With Codol to fill the gap between Stuart's straight grinding oils and new, highly detergent, petrochemical solution, Hi-D—your Stuart representative can provide the grinding fluid best suited to your particular work.

(Complete details are available on this application—ask for Bulletin #8.)

Call your Stuart representative for expert advice on grinding fluid problems—and remember, it's Codol when you want a slick finish.

Stuart **Productive Lubrication**

(Phone Stuart Representative listed at right)

D. A. STUART OIL CO., LIMITED

2727 South Troy Street, Chicago 23, Illinois • Phone: Bishop 7-7100

CANADIAN D. A. STUART OIL CO., LIMITED, P.O. Box 430, 43 Upton Road, Scarborough, Ontario, Canada

ATLANTA, Georgia
Henry E. Perkins
275 Danbury Lane
BLackburn 5-6926

BAYONNE, New Jersey
D. A. Stuart Oil Co., Ltd.
P. O. Box 137
HEmlock 7-0151

CINCINNATI 2, Ohio
c/o Queen City Warehouses, Inc.
42-56 Main Street
PArkway 1-3731

CLEVELAND 13, Ohio
D. A. Stuart Oil Co., Ltd.
1730 Train Avenue
PRospect 1-7411

DALLAS 35, Texas
The Royal Supply Company
6626 Maple, P. O. Box 35374
FLeetwood 1-3927

DAYTON 2, Ohio
c/o Union Storage Company
10 S. Conover Street
BAldwin 6-1871

DETROIT 4, Michigan
D. A. Stuart Oil Co., Ltd.
8350 Military Avenue
TYler 7-8500

ENGLEWOOD, Colorado
Western Oil Supply
3275 S. Santa Fe Drive
SUnset 1-1721

FORESTVILLE, Connecticut
D. A. Stuart Oil Co., Ltd.
c/o Paul's Cartage
215 Fredericks St.
JAckson 7-1144

HARTFORD 13, Connecticut
D. A. Stuart Oil Co., Ltd.
410 Asylum Street, Rm 336
JAckson 7-1144

HOUSTON, Texas
Ada Oil Company
6910 Fannin, P. O. Box 844
JAckson 6-1911

INDIANAPOLIS 7, Indiana
D. A. Stuart Oil Co., Ltd.
c/o Merchandise Whse. Co., Inc.
1414 South West Street
MElrose 2-2525

KANSAS CITY, Kansas
Interstate Oil Co.
87 Shawnee Avenue
DRexel 1-3470

LOS ANGELES 22, California
Los Angeles Oil & Grease Co.
2313 Yates Avenue
RAymond 3-1208

MINNEAPOLIS 4, Minnesota
The Satterlee Company
2200 E. Franklin Avenue
FEderal 3-5264

PHILADELPHIA 35, Pennsylvania
D. A. Stuart Oil Co., Ltd.
Wingate & Hagerman Streets
DEvonshire 8-6100

PORTLAND 4, Oregon
J. E. Haseltine & Co.
115 S.W. Second Avenue
P. O. Box 3342
CApitol 8-7511

ST. LOUIS 10, Missouri
Jenkin-Guerin Inc.
4480 Hunt Avenue
OLive 2-2905

SAN MATEO, California
Bay City Oil Co.
968 S. Bayshore Blvd.
DIamond 3-2090

SYRACUSE, New York
c/o Robert M. Haley Warehouse
404 N. Midler Avenue
Box 61, Eastwood Sta.
HOward 3-8647

SCARBOROUGH, Ontario, Canada
Canadian D. A. Stuart Oil Co., Ltd.
P. O. Box 430, 43 Upton Road
PLymouth 7-3227

EUROPE

SWITZERLAND, Bern
Walo v. Muhlenen
Effingerstrasse 75

BELGIUM, Brussels
Ets. Mottay & Pisart S.A., 65 rue du Lombard

DENMARK, Copenhagen-Gentofte
Firma P. V. Nordentoft, Brogaardsvaenge 1

ENGLAND, London W. 1
Amber Oils, Ltd., 11A Albemarle St.

FRANCE, Paris 17e
Dasco S.A., 2, rue Gounod

GERMANY, Frankfurt a.M.
D. A. Stuart Industrieöle G.m.b.H.
Cassellastrasse 31

ITALY, Milan
Univers S.p.A., Via Valvassori Peroni N. 47a

SWEDEN, Stockholm—Vartan
A. B. Gullander & Co., Postfack

SWITZERLAND, Bern
N. v. Muhlenen G.m.b.H., Schlosstrasse 131

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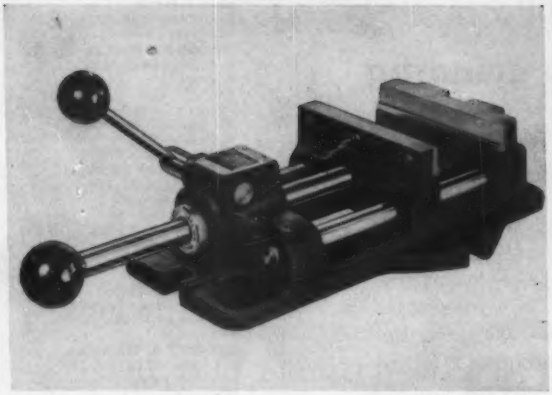


Precision-built drill-press vise made by the L-W Chuck Co.

"Honite" tumbling barrel media for finishing die-castings

Drill-Press Vise

A line of precision-built drill-press vises and fixture holders designed to safely handle both rigid and nonrigid work without distortion has just been made available by the L-W Chuck Co., Toledo, Ohio. There are three sizes: 4, 6, and 8 inches. The maximum openings are 5 1/2, 6 1/4, and 8 1/2 inches, respectively.

A turn of the front adjusting screw bushing varies the jaw pressure from 1 to 1500 pounds. Easy hand pressure on a hardened and micro-ground bar locks and holds the work. Heavy, removable jaw inserts allow simple, quick adaptation for low-cost jigs and fixtures.

Circle Item 601 on postcard, page 195

Media for Barrel Finishing

A barrel-finishing media designed for zinc die-castings, which offers fast cutdown, produces a low micro-inch surface finish, and protects work-pieces against surface impingement, has been announced by the Minnesota Mining & Mfg. Co., St. Paul, Minn. Called "Honite" brand Z-N tumbling shape, the new media is said to offer characteristics not previously available in any other for barrel finishing zinc die-castings.

The rapid cutting rate of the media serves to reduce the barrel-tumbling time. Its exclusive fine-mesh abrasive produces a finish so fine that hand buffing is often eliminated in the preparation of a pre-plate finish. Slough-suspending chip action allows work-pieces to come out cleaner and brighter. The light weight of the media assures work-pieces free of media impingement, and the product's fracture resistance minimizes lodging problems. Present media shape is that of a truncated pyramid.

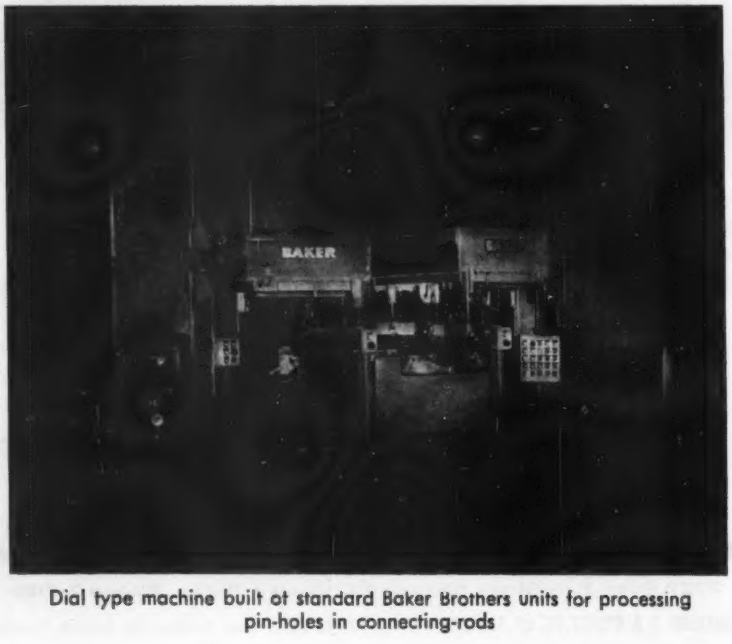
It is claimed that many zinc die-castings previously not mass-processed because of a lack of suitable media to generate an acceptable pre-plate finish can now be barrel finished and take a plate comparable to a hand-buffed piece.

Circle Item 602 on postcard, page 195

Vertical Dial Type Machine for Processing Pin-Holes in Connecting-Rods

A vertical index or dial machine made completely of standard units has been designed and built by Baker Brothers, Inc., Toledo, Ohio, for processing the pin-holes in automotive connecting-rods. The machine cycle is as follows: load four parts in each fixture; drill to one-half the hole depth; drill through; ream; and chamfer. The production rate is 600 parts per hour.

The hydraulic index-table, a



Dial type machine built of standard Baker Brothers units for processing pin-holes in connecting-rods

NEW *from* GRAND RAPIDS

and just look at all these features:

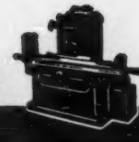
- Powered vertical movement of wheel head*
- Instantly variable hydraulic table speed
- Greased-for-life precision ball bearing spindle with two speeds for long wheel life
- Head carried on protected pre-loaded ball bearing ways
- Equipped with Vickers vane type pump and our own control valve for infinite longitudinal table speeds from 5" to 120' per minute
- Variable speeds hydraulic cross feed and continuous cross feed
- Rugged, one-piece casting column and base for permanent rigid alignment
- Ultimate in accuracy with micro inch finish at production speeds

**Automatic downfeed available as optional feature*

No. 350 PRECISION TOOL ROOM TYPE HYDRAULIC FEED SURFACE GRINDER

For full details, just send a note on your letterhead.

GALLMEYER & LIVINGSTON CO.
305 Straight Ave., S.W., Grand Rapids, Mich.



GALLMEYER & LIVINGSTON

new standard unit designed for quick and easy servicing, permits removal of all components from the outside without disturbing the fixtures or the index-table top.

The fixed-center drilling units assembled with the hydraulic table are designated as A-24-VF and A-18-VF.

Circle Item 603 on postcard, page 195

draulic power supplied by a separate hydraulic pump and tank unit. Electrical controls are housed in a separate control cabinet.

Circle Item 604 on postcard, page 195

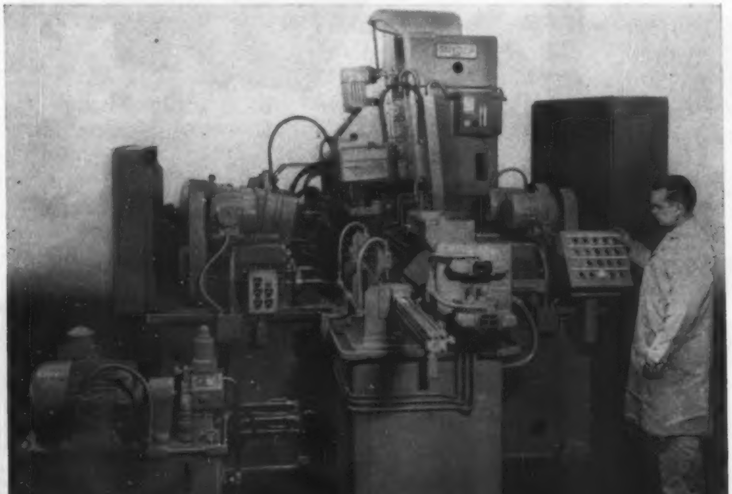
Snyder Automated Machine for Drilling Rocker-Arm Shafts

A fully automated, six-station in-line transfer machine that drills and probes holes in truck-engine rocker-arm shafts at the rate of 211 parts per hour is announced by the Snyder Corporation, Detroit, Mich. The rocker-arm shafts are delivered to a transfer way from a hopper-feed and escapement mechanism at one end of the unit. A rotating-finger transfer bar actuated by a hydraulic cylinder at the end of the transfer way advances the SAE 1010 tubular rocker-arm shafts from station to station for the various drilling and probing operations. The rocker-arm shafts are 17 inches long and have an outside diameter of 3/4 inch.

Individual parts are lifted a small amount by spring-loaded centering fingers that enter each end during the transfer operations between stations. Clamping fixtures at each station locate the parts for the machining and checking operations. One of the holes produced in the first drilling station is utilized as a radial locating point for succeeding drilling, idle, and probing operations.

When the machine is in operation, parts from the hopper are placed on the transfer way at Station 1. Station 2 has a pair of opposed drilling units that drill one 11/32-inch and three 13/32-inch holes. Station 3 is idle but has a clamping fixture and hole locator to prevent part rotation. At Station 4 there is one horizontal and one vertical drill head. Each head drills six 1/8-inch holes. Station 5 is an idle station with a clamping fixture and hole locator. At Station 6 the two sets of six 1/8-inch drilled holes are probed to check for broken drills or incomplete holes. The machine shuts down automatically if the probes indicate incorrect drilling.

The machine occupies a floor space approximately 16 feet by 9 feet. The hydraulically operated, electrically controlled unit has hydraulic power supplied by a separate hydraulic pump and tank unit.



Snyder fully automated in-line transfer machine that drills and probes 211 truck-engine rocker-arm shafts per hour

Wilson hydraulic arbor press

Air-Actuated Hand-Operated Hydraulic Arbor Press

A 10-ton, hand-operated hydraulic bench arbor press featuring an air-actuated, fast ram approach is announced by K. R. Wilson, Inc., Arcade, N. Y. This press is adaptable to a wide range of bending, straightening, forming, and punching applications. It can be operated at more than twenty strokes per minute. Raising the hand operating lever causes the ram to come down to meet the work in a fraction of a second. When the hand lever is lowered, hydraulic pressure is applied to the work. Once the job is done, the ram is quickly spring-returned to top position by simply flipping the pressure-release knob above the pumping unit.

Welded steel, boxed-column frame construction, and heavy channel base assure maximum rigidity. The operating lever is readily adjustable to suit individual needs. Equipment includes a pressing plate and two matched V-blocks for straightening and bending operations. A sturdy floor stand is available.

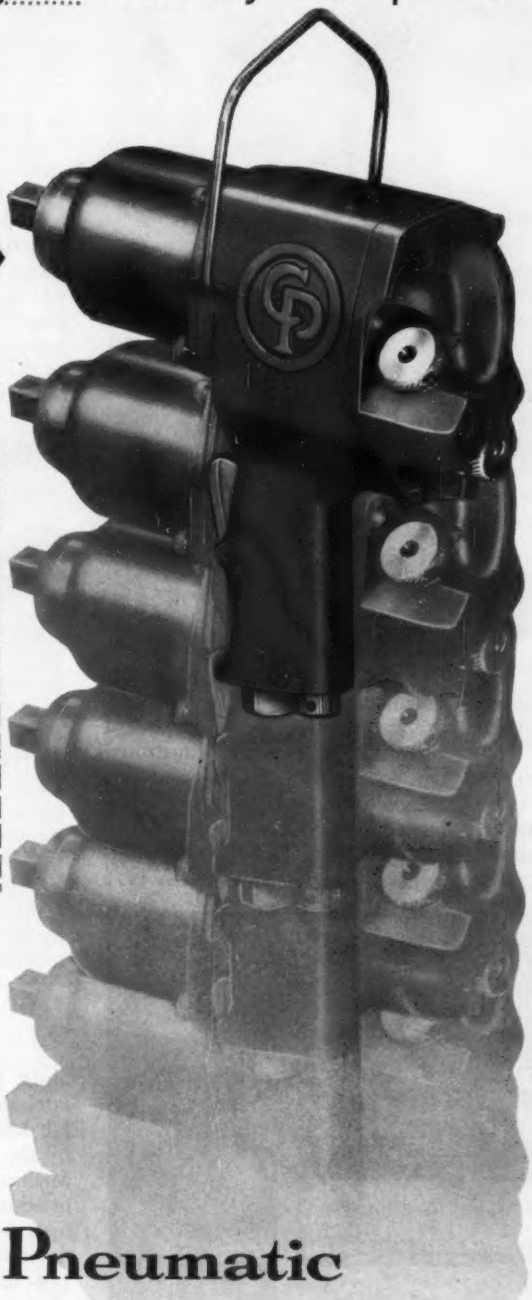
Circle Item 605 on postcard, page 195

(This section continued on page 224)

don't underestimate
the importance of

PROPER BOLT TIGHTNESS

in your assembly line operations!



CP-3440-TS adjustable torque range 15 to 80 ft-lbs. ½" square drive.

TORQUE CONTROL IMPACT WRENCHES

CP-3630-RTP adjustable torque range 100 to 350 ft-lbs. ¾" or 1" square drive.

CP-610-RTP adjustable torque range 300 to 600 ft-lbs. 1" square drive.

* A complete line of Torque Control Screwdrivers and Nutrunners solve other threaded fastener torque problems. Available from No. 4 screw size to ⅜" bolt size.

More and more top-flight manufacturers are realizing that *proper bolt tightness* is a quality factor that gives them a sales edge over competitive products . . . their assembly line foremen know that the use of TORQUE CONTROL IMPACT WRENCHES in the driving of nuts and bolts to "correct torque" means:

- Less work spoilage
- No chance of sheared bolts or stripped threads
- Inexperienced operators learn nut running operations faster
- Less product failure

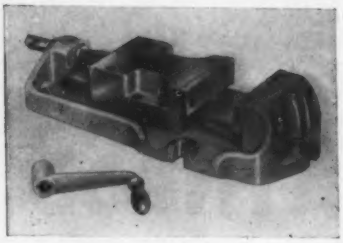
CP Torque Control Impact Wrenches give you the exact tightness you want in a fast, accurate, "one-shot" rundown that doesn't require a hand torquing follow-up to check work accuracy. Torque ranges from 15 to 600 foot pounds available.

Let a CP Fastener Specialist work with you on your problems. You'll be impressed by the easy handling qualities of these unusually compact tools. The torque control mechanism is totally enclosed and *all torque adjustments* are made quickly AND simply without special tools or fixtures. For further information, contact your nearest CP Office, or write: *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, N. Y.*

Chicago Pneumatic

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

For more data, circle this page number on inquiry card



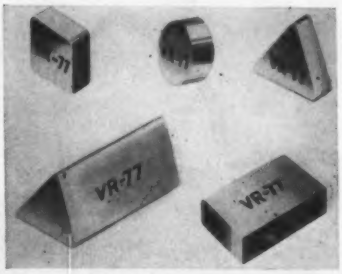
Vise with Coolant Trough

One of a line of vises made of ductile iron, a new metal developed to combine the best features of steel and cast iron. The Skinner Chuck Co., New Britain, Conn., claims that the unique properties of ductile iron will enable the bases to hold up longer in service with far less maintenance and at a lower over-all cost. The new metal is said to give the vises extra strength to resist cracking, toughness to take abuse, hardness to withstand heavy blows, and extra rigidity for extreme accuracy and holding power. These vises feature a large trough for guiding the coolant to its container. A swivel base for setting this vise at any angle is optional. Jaw capacities are 4, 5, 6, 7, and 8 inches.

Circle Item 606 on postcard, page 195

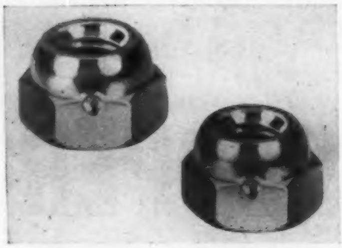
VR-77 Carbide in New Sizes

Five of the thirty-four new stock sizes of VR-77 carbide announced by Vascoloy-Ramet Corporation, Waukegan, Ill., to meet the rapidly increasing demands of many machining applications. Excellent shock resistance and very high resistance to deformation by heat make this carbide well adapted



for many extremely tough cutting jobs. It has proved to be an outstanding grade for heavy roughing and interrupted cutting of all types of steel—including high tensile strength and heat-resistant alloys. Stock items include many sizes of square and triangular throw-away inserts for both positive and negative rake holders.

Circle Item 608 on postcard, page 195



Open-End Acorn Lock-Nuts

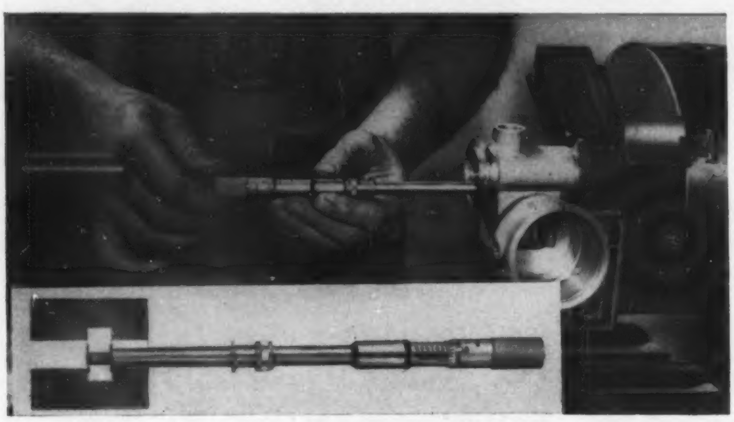
Torque lock-nut of open-end acorn design now available from Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y. Two stakings in the nut side distort threads slightly to lock the nut to the screw. Since it is all metal and one piece, this lock-nut is low-cost. Current applications include metal furniture, appliances, portable barbecue grills, and similar products where pleasing appearance and rounded contours are desirable. Available in steel and aluminum in No. 10, 1/4- and 5/16-inch sizes.

Circle Item 609 on postcard, page 195

"Multi-Mike" Internal Micrometer

Internal micrometer, called the "Multi-Mike," which measures cylinder groove and land widths, O-ring widths, and groove and keyway locations. Measurements that are accurate to 0.0005 inch are possible with this instrument for groove widths from 0.050 inch to 1.050 inches. Lands from zero to 1.000 inch and distances between grooves can also be measured with the same degree of accuracy. The model illustrated will locate from an external reference to its probe depth of 5 3/4 inches. Announced by Navan Products, Inc., El Segundo, Calif.

Circle Item 607 on postcard, page 195



Safety Latch for Hoist Hooks

Hoist hook equipped with safety latch designed to prevent accidental detaching of loads introduced by the Harrington Co., Plymouth Meeting, Pa. This latch can be fitted on any hoist hook in minutes to provide complete safety. The device is available in four sizes for 1/4- to 3-ton hooks.

Circle Item 610 on postcard, page 195

Feature for feature,
Price for price . . .*

this CINCINNATI 16" ROYAL DRILL is your BEST DRILLING BUY!

CHECK LIST FOR DRILLING AT A PROFIT

SPINDLE ACCURACY
6-spline spindle mounted in 4 precision bearings—one at TOP and bottom of spindle pulley.

BUILT-IN ELECTRICS
Complete controls with overload protection built into the head.

POSITIVE DEPTH GAGE
Easy-to-read gage is graduated in 1/16". Quickly set for positive stop at desired position.

RAPID SPEED CHANGE
Tilting motor bracket provides easy belt shifting for five spindle speeds.

SPACIOUS TABLES
Large working surface of tables and bases, with massive 3" column design provide unusually wide work range.

APPEARANCE
Streamlined functionally for maximum safety and operating ease.

ACCESSORIES
Profit-boosting attachments and accessories include automatic air feeds, electrical tapping units, motor driven coolant pump, and others.

The CINCINNATI 16" ROYAL Drill is a real metal-working drill, built to machine tool quality standards by a machine tool builder. This is a multi-purpose machine—it handles light drilling on a production basis, as well as being ideal for utility operations. With CINCINNATI quality built-in, a ROYAL holds its accuracy longer—stays on the job longer.

*Only $128 for the Cincinnati 16" Royal bench type drill shown. Complete with 0"—½" chuck or #2 M.T. spindle, built-in single phase manual control with overload protection—less motor. Floor model, as above, only $143.

ROYALS are built in bench and floor types, single and multiple spindle 16" models with ⅝" drilling capacity in cast iron. Also 18" models with 1" capacity in cast iron.

Talk it over with your CL&T Dealer, or write us direct.

Improved Machining Through Research

CINCINNATI LATHE AND TOOL CO.

3207 Disney Street • Cincinnati 9, Ohio

"TRAY-TOP" Lathes / "CINCINNATI" Drilling Machines / "SPIROPOINT" Drill Sharpeners

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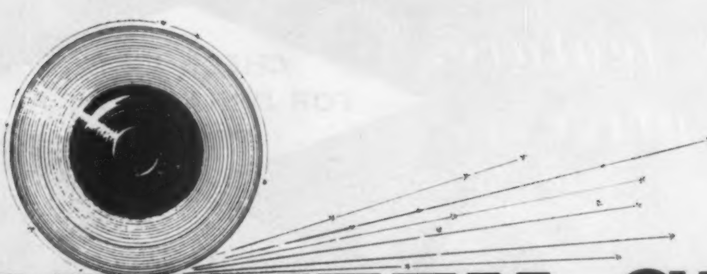


By E. S. Salichs

BETWEEN GRINDS

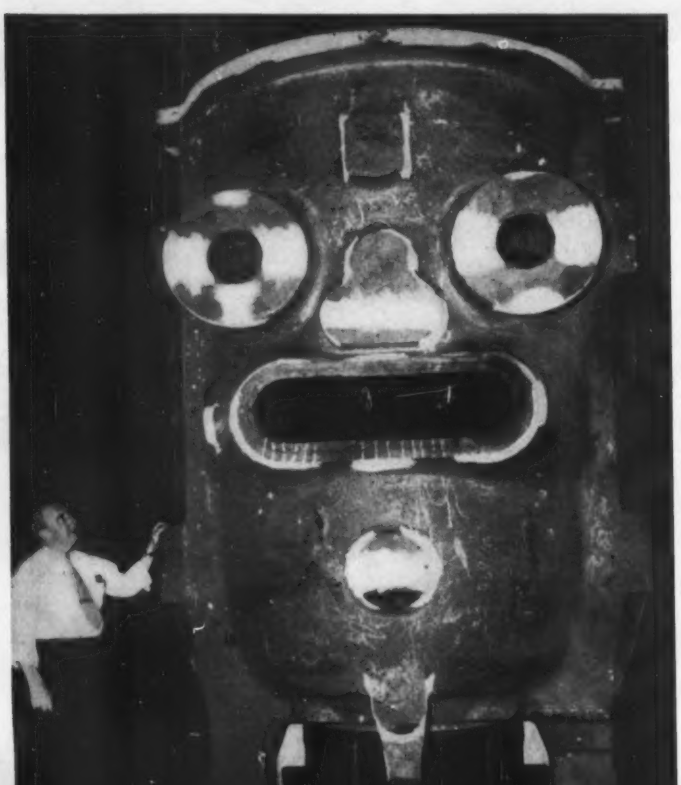
Our Words on Wings

A foreign subscriber to MACHINERY, T. Van Kampen of Amsterdam, Holland, is so anxious to read his monthly copies without delay that he has paid $35 extra for air mail postage this year. Were it possible, Mynheer, we would print your copies on India paper.

Decal Daisies

The Meyercord Co. has pointed out how it takes advantage of certain facts in making up decal designs for business advertising. For instance—a transfer company named "Weathers" was given this treatment: a decal "Call Weathers in any Weather," with two faces, one sunny, one frosty. So you don't have an easy name—we're sure a company accustomed to sticking things will not be stuck.

HI, HAPPY—Not first cousin to Superman, but simply a portion of a steam-turbine high-pressure shell which will be part of the largest electric-power generating machine in the Caribbean Sea area, scheduled for operation in San Juan, Puerto Rico. It is being manufactured by the Medium Steam Turbine, Generator and Gear Department of the General Electric Co. Fortunately, subsequent machining and drilling operations will alter the appearance of the turbine which otherwise might frighten the jibaritos (hillbillies, Spanish style) returning to their casas from fiestas.



Is Webster Willing?

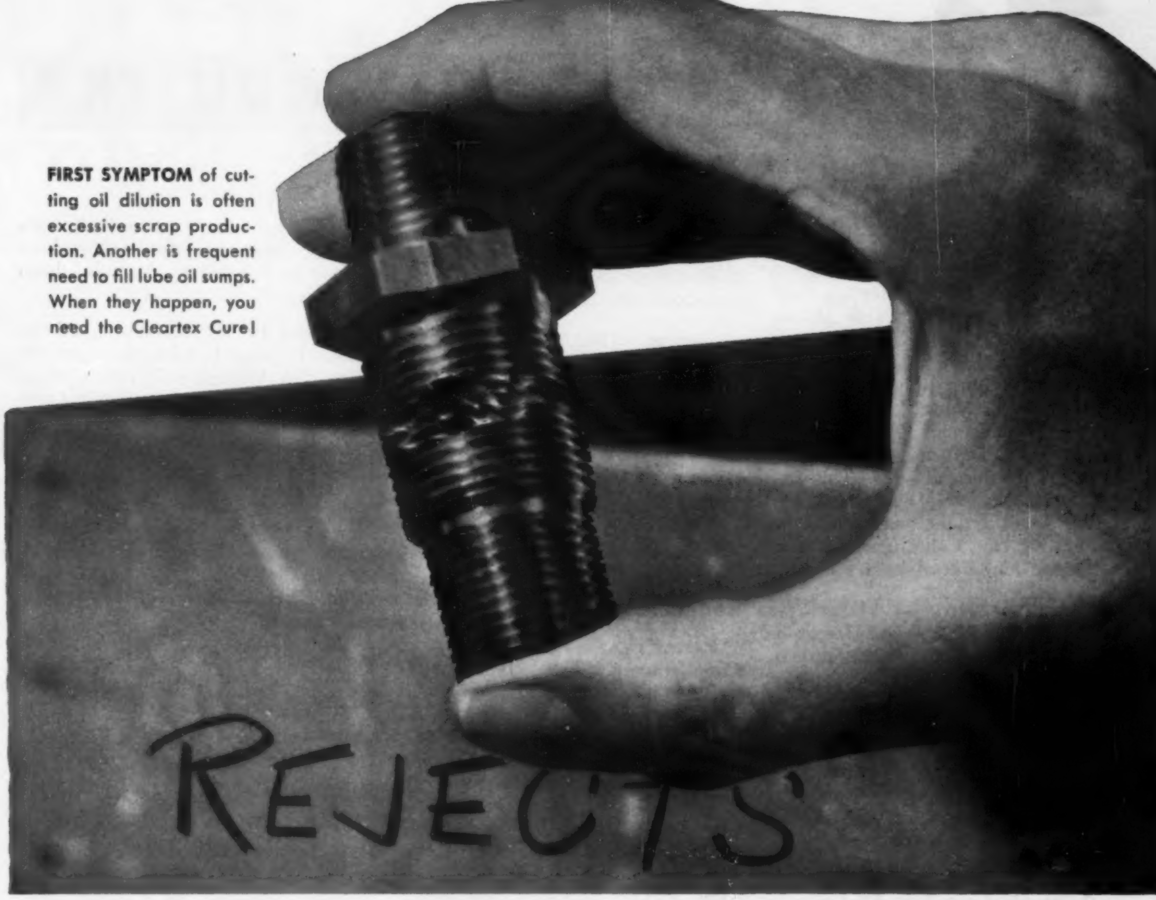
Making use of the medical ending "iatrics," Pittsburgh engineer Douglas E. Noll introduced the word "thermiatrics" in his talk to power plant specialists at a recent ASME meeting, defining it as "a disease afflicting boilers operating at high temperatures." Mr. Noll pointed out, however, that engineers could take a course of action not normally open to the medics—they could use tougher, resistant materials in tomorrow's boilers.

"Rock-and-Roll" Research

Cleaver-Brooks engineers are simulating actual sea conditions in order to test the operating efficiency of distillation equipment for marine use. The test machine consists of a rocking fixture which duplicates oceanic surface conditions through a horizontal roll up to 45 degrees and a vertical pitch up to 15 degrees. It can be operated manually or automatically through limit switches. But if the operator is susceptible to motion he may stagger home nightly—brine, not beer, his downfall.

Fit the Strip

Build your roads in a factory? According to *Industrial Research Newsletter,* it is being done in Stuttgart, Germany, where cement blocks are manufactured and dried in a plant, then taken to a road site which has been prepared, fitted over the bed, and covered with asphalt, ready for traffic without the customary wait for concrete to dry. Does it do away with detours, too?



FIRST SYMPTOM of cutting oil dilution is often excessive scrap production. Another is frequent need to fill lube oil sumps. When they happen, you need the Cleartex Cure!

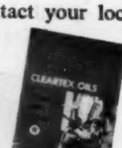
Diluted cutting oil can pile up rejects

When you find your scrap production soaring, the villain may be lube oil leaking into the cutting oil sumps of your automatic screw machines. It happens in 7 out of 10 automatics in spite of the most careful lubricating techniques. This dilution will lower cutting oil effectiveness—and, as it loses its efficiency, rejects pile up, tool life drops, and production can go down by as much as 33 per cent!

Texaco Cleartex can solve the problem—forever!
Because of its exceptional stability and load-carrying ability, Cleartex can function *both* as a cutting oil *and* as a lubricant —and even as a hydraulic fluid. When *all* your automatics' sumps are filled with Cleartex, unavoidable leakage is no longer a problem. Excessive scrap production will stop, tools will last longer and production will go up.

TAKE THE "CLEARTEX CURE" SOON!
Write today for your copy of Texaco's new booklet—"Cleartex in Automatic Screw Machines." This new illustrated guide will fill you in on the details, show you where you may be losing profits and how to avoid it. Or contact your local Texaco Lubrication Engineer for an authoritative survey of your automatics. Just call the nearest of the more than 2,000 Texaco Distributing Plants, or write:

Texaco Inc., 135 East 42nd Street, New York 17, N. Y., Dept. MA-32.



☆ ☆ ☆

Tune In: Texaco Huntley-Brinkley Report, Mon.-Fri.-NBC-TV

TEXACO

Throughout the United States
Canada • Latin America • West Africa

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

News OF THE INDUSTRY

California

L. D. MARTIN AND ASSOCIATES, Rochester 4, N. Y., are moving their consulting services to California on September 1. Their California address will be 553 E. Walnut St., Pasadena, Calif., Room 208. Mr. Martin was director of gear engineering for the Eastman Kodak Co. for over thirty years prior to the establishment of this business. This organization, rendering gear consulting service, will be the exclusive representative in California for the Schoeppe and Faeser gear checker.

HAMILTON DIVISION, Hamilton, Ohio, of Baldwin-Lima-Hamilton Corporation has appointed SEABOARD MACHINERY CO., 3212 E. Olympic Blvd., Los Angeles, Calif., as southern California sales representative for Hamilton mechanical and hydraulic presses. The Seaboard sales territory includes all California counties south of, and including, San Luis Obispo, Kern, and San Bernardino.

JAMES M. BELL has been named to the newly created position of assistant vice-president of sales in charge of the western division for RUSSELL, BURDSALL & WARD BOLT AND NUT CO., Port Chester, N. Y. Mr. Bell's office will be at 4466 Worth St., Los Angeles 63, Calif.

LOUIS M. BALLARD has been appointed president of MICRO-PATH, INC., a wholly owned subsidiary of Topp Industries, Inc., Los Angeles, Calif. Micro-Path manufactures automated controls for industry.

JOSEPH T. RYERSON & SON, INC., San Francisco, Calif., has announced that Reynolds aluminum had been added to the company's stocks and that service on aluminum, in addition to service on steel, was being given to metal users in the northern California area. Heading the new aluminum sales department is THOMAS A. EDWARDS.

Louis M. Ballard, president, Micro-Path, Inc.

Connecticut

FAFNIR BEARING CO., New Britain, Conn., announced six major appointments in its Product Engineering and Metallurgical Divisions. HORACE B. VAN DORN was appointed director of engineering, a new post. HOWELL L. POTTER was named assistant director of engineering. FRANCIS G. PATTERSON was appointed chief product engineer. A. BURTON JONES, JR., was made chief research engineer. HENRY HUBBELL succeeded Mr. Van Dorn as technical development manager. Mr. Hubbell was formerly chief metallurgist. PHILIP K. PEARSON, JR., was appointed chief plant metallurgist, succeeding Mr. Hubbell.

TORRINGTON CO., Torrington, Conn., announces the appointment of MARSHALL & HUSCHART MACHINERY CO., Chicago, Ill., as authorized representative in the Midwest for Torrington rotary swaging machines, dies, and parts. The Marshall & Huschart Co. maintains branch offices in Milwaukee, Rockford, and Rock Island, Ill., and South Bend, Ind. They will handle sales and service on Torrington swaging machines in the states of Iowa, southern Wisconsin, northern Illinois, western Indiana, and Michigan.

BULLARD CO., Bridgeport, Conn., will establish, on September 8, an Eastern Sales District, with headquarters in Bridgeport, with CLIFFORD H. HAGBERG as Eastern District manager. The new district will include present sales territories of New England, New York State, metropolitan New York, and Philadelphia. The appointment of DONALD T. BENSON as salesman for the metropolitan New York territory has also been announced.

JAMES H. W. CONKLIN has been named general sales manager of PRATT & WHITNEY CO., INC., West Hartford, Conn. Mr. Conklin will direct all domestic sales and marketing activities for the company's line.

NORMA - HOFFMANN BEARINGS CORPORATION, Stamford, Conn., has added two men to its field sales force. ROBERT P. RYNDRESS will represent the company in the Detroit area, and MICHAEL MCGREW in Cleveland.

HERBERT A. FRANCE, JR., was appointed manager of quality control for PRATT & WHITNEY CO., INC., West Hartford, Conn.

Illinois

J. J. ROZNER has been elected president of the AETNA BALL & ROLLER BEARING CO., Chicago, Ill., by the board of directors of the parent Parkersburg-Aetna Corporation. He is also a vice-president and member of the board of directors of the Parkersburg-Aetna Corporation.

THOMAS P. SAWYER has been appointed sales manager of ARMSTRONG BROS. TOOL CO., Chicago, Ill., succeeding the late Henry B. Austin. Mr.

Thomas P. Sawyer, sales manager, Armstrong Bros. Tool Co.

30% TO 50% LONGER LIFE FOR RESINOID-BONDED DIAMOND WHEELS

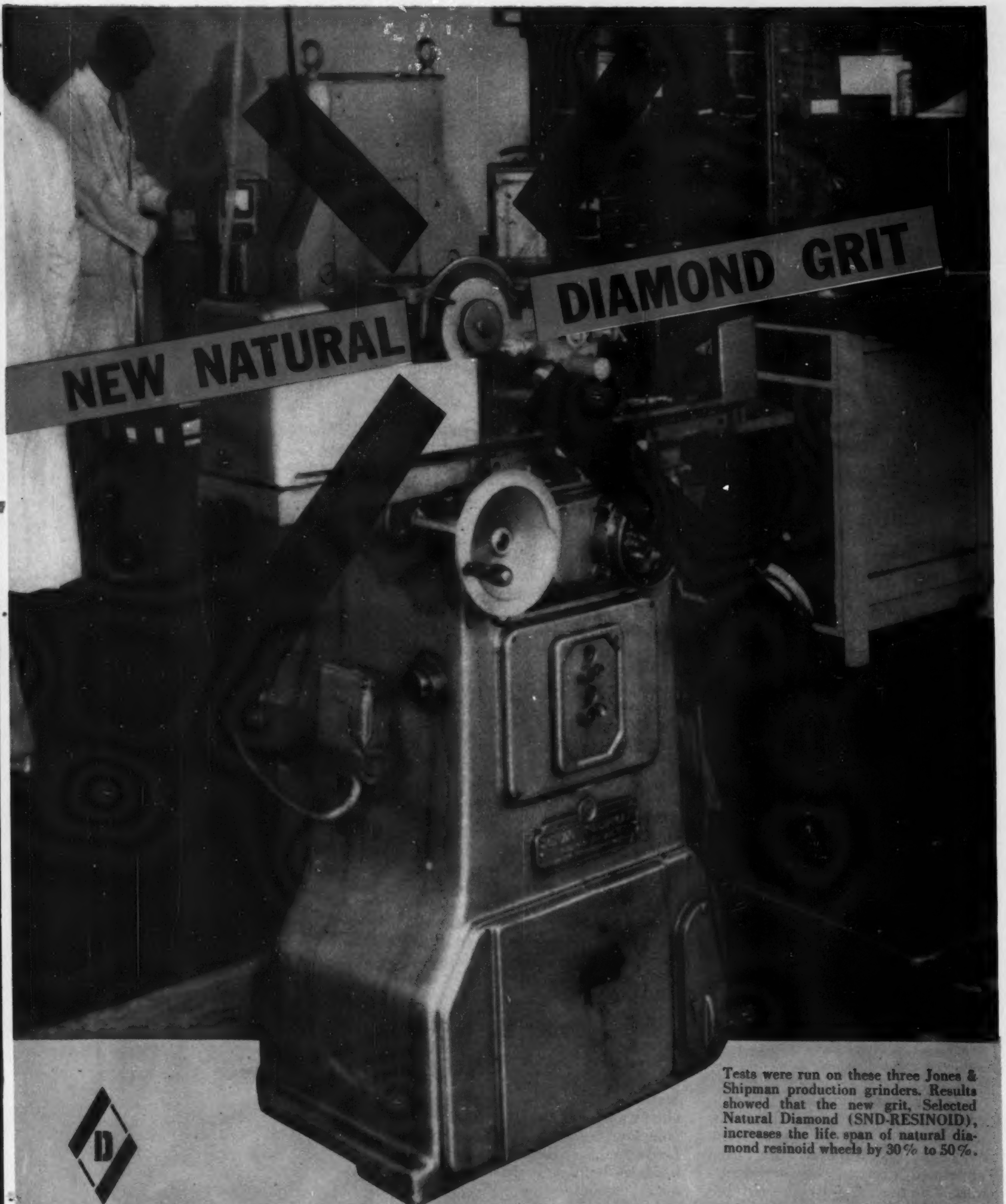
Six hundred separate trials, using 145 wheels, were run by the Diamond Research Laboratory to test a completely new type of natural diamond grit for resinoid wheels. The results: this new grit increases the life of natural diamond resinoid-bonded wheels by 30% to 50%.

The particles of this new grit do not readily pull out of the bond. Instead, they break down into ever-finer fragments which constantly expose new, sharp cutting surfaces.

TEST EQUIPMENT: Three 18" Jones & Shipman production grinders were fitted with special spindles to enable wheels to operate at 5500 surface feet per minute, the speed generally used in diamond grinding.

The wheels were of the D1A1 type, 6" in diameter, 3/16" face width, with 1/8" depth of resin. Each wheel contained 31 1/4 carats of the new grit. Metal to be ground was tungsten carbide of the same quality normally used for milling cutters, lathe tools, etc. During the course of the tests, 700 pounds of hardest carbide were ground away.

RESULTS: This new friable grit, Selected Natural Diamond (SND-RESINOID), increases the life of natural diamond resinoid wheels by 30% to 50%, depending on the type of job at hand. The grit will be available to your wheel manufacturer soon. Next time you order diamond resinoid wheels, specify SND-RESINOID . . . the most economical *and* the most efficient grit you can use.


NEW NATURAL
DIAMOND GRIT



(Left) Paul C. Kjelstrom, sales manager, Mechanical Press Division, (center) C. J. Warmac, sales manager, Hydraulic Division, and (right) Walter C. Johnson, assistant vice-president—administration, Verson Allsteel Press Co.

Sawyer has been serving as eastern district sales manager since 1957.

PARKER-HANNIFIN CORPORATION, Cleveland, Ohio, announces the appointment of WALLACE TUBE DIVISION, 1300 Diversey Parkway, Chicago 14, Ill., as a franchised distributor of Parker hydraulic accumulators. Wallace Tube also has call on the assistance of GEORGE C. STEPHENS, Parker-Hannifin manager of distributor sales in the Chicago district.

CLEARING Division of U. S. Industries, Inc., Chicago, Ill., recently announced the appointment of WILLIAM ROORDA as director of production engineering. ROBERT B. YOCUM, formerly in the Lansing area for Clearing, has been transferred to the Detroit office as district sales engineer. Locating in Flint as district sales engineer is ROBERT J. FALSEY.

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., announces the appointments of CHARLES C. LUND and ROBERT H. WALKER as district sales managers. Each will be responsible for the promotion of sales of all Ryerson steel, aluminum, industrial plastic, and machinery products in selected sales districts.

VERSON ALLSTEEL PRESS CO., Chicago, Ill., has announced three new appointments in the organization. WALTER C. JOHNSON has been appointed assistant vice-president—administration. He has served the company since 1944 in diverse capacities. C. J. WARMAC has been appointed sales manager, Hydraulic Division. PAUL C. KJELSTROM has been appointed sales manager, Mechanical Press Division. His background of eighteen years with Verson includes positions as chief engineer, service manager, and executive assistant. All three men will make their headquarters in Chicago.

Michigan

DOW CORNING CORPORATION, Midland, Mich., announces that WILLIAM W. PEDERSEN, manager of the corporation's Cleveland sales office, is being transferred to the main office, Midland, Mich. Mr. Pedersen becomes a full-time member of a new corporate planning committee reporting to the president. This group, which includes R. W. CALDWELL and A. W. RHODES, will study and make recommendations regarding such corporate activities as the addition of new product lines and the expansion of existing ones, manufacturing, development, and marketing facilities, plant locations, and other matters related to the growth of the business. MAX H. LEAVENWORTH, now manager of the southwestern branch in Dallas, will become manager of the Cleveland office. EDWIN HAIRE of the Dallas offiice will succeed Mr. Leavenworth as manager.

MICROMATIC HONE CORPORATION, Detroit, Mich., announces that Micromatic is now the exclusive sales and service source in the United States and Canada for grinding machines manufactured by its associate company, A. A. JONES & SHIPMAN of Leicester, England. Jones-Shipman has been building and selling Micromatic honing equipment overseas since 1950. This close association between the two leading companies in their respective fields has resulted in the decision to link the Jones-Shipman line of toolroom grinders to Micromatic coverage.

WESSON CO., Detroit, Mich., has named two sales engineers and two distributors. HERBERT D. GROTH and JAMES J. WALSH will be working out of the Wesson Cleveland District office (Rocky River) to service metalworking plants in northeastern Ohio. The J AND W TOOLING INC., Greensburg, Pa., will be active in the Pittsburgh area and BELOIT INDUSTRIAL SUPPLY CO., Beloit, Wis., will service companies in southern Wisconsin and northwestern Illinois.

BUHR MACHINE TOOL CO., Ann Arbor, Mich., announced the promotion of CHESTER S. JOHNS to the position of general sales manager, formerly held by A. A. Vetter. The company also has announced the addition of WALTER R. NAAS as a sales engineer in the Buhr direct sales office. Mr. Naas will serve selected companies in the Detroit and Windsor metropolitan areas that use multiple-operation machine tools.

Chester S. Johns, general sales manager, Buhr Machine Tool Co.

(Left) O. T. Thompson, district manager, and (right) H. H. Moeller, branch manager, Detroit area, Carpenter Steel Co.

CARPENTER STEEL CO., Reading, Pa., has appointed two men to managerial posts in the Detroit area. O. T. THOMPSON, formerly branch manager of Detroit, now becomes district manager, following the retirement of C. O. ERICKE. H. H. MOELLER has been promoted to branch manager of Detroit, succeeding Mr. Thompson. Moeller has been a sales representative in the Detroit territory since 1950.

Minnesota, Missouri, and Texas

DR. FINN J. LARSEN has been named to the newly created post of vice-president in charge of research for MINNEAPOLIS-HONEYWELL REGULATOR CO., Minneapolis, Minn.

WAGNER ELECTRIC CORPORATION, St. Louis, Mo., announces that GEORGE W. BROWN was elected president and will serve as chief executive officer of the corporation. He was also elected president of its subsidiary, Wagner Brake Co., Ltd., Toronto, Canada. He succeeds the late J. H. DEVOR.

GORDEN WADE DAVIS, 5122 Hialeah, Houston, Tex., has been appointed southwestern sales representative for MORSE TWIST DRILL & MACHINE CO., New Bedford, Mass.

New York and New Jersey

FARREL-BIRMINGHAM CO., Ansonia, Conn., has moved the headquarters of industrial gear sales from the company's main office in Ansonia to its gear manufacturing plant, 344 Vulcan St., Buffalo, N. Y. RUDOLPH C. WILSON, who continues as manager, and PIERCE BIRKHOFF, who has been appointed assistant manager, are both transferring to the new location. RICHARD T. PENHALL and JOHN ERKER have also been assigned to the Buffalo sales office. JOSEPH H. ALLEN, who has been appointed manager, eastern area industrial gear sales, will remain at Ansonia. He will be assisted by FRANK LARKIN.

GEORGE H. BLANK has been appointed sales manager of JOSEPH T. RYERSON & SON, INC., Buffalo, N. Y.

RUSSELL, BURDSALL & WARD BOLT AND NUT CO., Port Chester, N. Y., announces the appointment of three new plant managers. LAMBERT M. KASPERS, plant manager at the company's Rock Falls, Ill., plant, since 1955, was named to the newly created position of Port Chester plant manager and assistant to the general manager. GEORGE J. NIEMAN was appointed plant manager at Rock Falls to succeed Mr. Kaspers. RONALD M. BOWMAN was named assistant manager at Rock Falls, another newly created post.

JOHN I. CHENEY has been appointed West Coast District manager of J. H. WILLIAMS & CO., Buffalo, N. Y. Mr. Cheney, now in charge of the company's district office and warehouse in Los Angeles, will supervise sales in California, Nevada, Arizona, and New Mexico.

FREDERICK A. FIELDER has been elected vice-president and general manager of the LOEWY-HYDROPRESS DIVISION, New York City, of the Baldwin-Lima-Hamilton Corporation. Mr. Fielder succeeds the late ERWIN LOEWY.

JAMES N. F. REYNOLDS, JR., has been appointed vice-president—manufacturing for VAN NORMAN INDUSTRIES, INC., New York City.

HARRY H. JASON has been appointed manager—Atlantic District of the General Electric Co.'s METALLURGICAL PRODUCTS DEPARTMENT, Detroit, Mich. Mr. Jason will be responsible for all sales and service activities of the district's Carboloy cemented carbide and related products. He will be located at the Atlantic District headquarters, 760 Colfax, Kenilworth, N. J. The Atlantic District covers all of New England, Delaware, Maryland, and the eastern portions of New York, Pennsylvania, and Virginia.

O. J. DONOHUE has been appointed administrative assistant, eastern region, AIR REDUCTION SALES CO., Union, N. J. Mr. Donohue has until the present time been district manager of Airco's Metropolitan District located in Jersey City. Mr. Donohue will be succeeded by C. D. L. PERKINS as district manager of the Metropolitan District.

(Left) George J. Nieman, plant manager, Rock Falls, Ill., and (right) Lambert M. Kaspers, assistant to general manager and plant manager, Port Chester, N. Y., Russell, Burdsall & Ward Bolt and Nut Co.

J. E. Dato, sales manager, electric welding, Linde Company

J. E. DATO has been appointed sales manager, electric welding, of THE LINDE COMPANY, Division of Union Carbide Corporation, New York City. His previous assignment was manager–electric welding, eastern region. His association with The Linde Company began with a field assignment in 1936.

Ohio

LINCOLN ELECTRIC CO., Cleveland, Ohio, elected the following vice-presidents: ROBERT A. WILSON, GEORGE F. WILLIS, and EDWIN M. MILLER. GEORGE F. CLIPSHAM was elected secretary.

R. THORNTON BEEGHLY has been elected president of METAL CARBIDES CORPORATION, Youngstown, Ohio. Mr. Beeghly succeeds his father, L. A. Beeghly, who founded the company and headed it since its organization in 1931. Other officers elected were: J. A. RITZ, vice-president, D. B. PETERSON, treasurer, and W. E. SCHEETZ, secretary.

R. Thornton Beeghly, president, Metal Carbides Corporation

MOTCH & MERRYWEATHER MACHINERY CO., Cleveland, Ohio, announces the purchase of MODERN TOOL CORPORATION and RADIAL CUTTER MFG. CORPORATION, Elizabeth, N. J. Plant facilities will be moved to Cleveland, Ohio, and made a part of the company's Cutting Tool Mfg. Division. Distribution will be handled through Motch & Merryweather's present organization.

Pennsylvania and District of Columbia

SKF INDUSTRIES, INC., Philadelphia, Pa., announces that HENRY D. HINEMAN has been appointed field engineer with the Pittsburgh district sales office. DAVID B. EDEN has been appointed to the newly created position of director of distributor sales of the company. Mr. Eden will be responsible for all domestic distributor sales and the operation of field warehouses.

LINK-BELT CO., Chicago, Ill., announces that BYRON K. HARTMAN has been appointed vice-president and general manager of SYNTRON CO., Homer City, Pa. Syntron is a subsidiary of Link-Belt. ROBERT G. BOTTORF has been appointed sales manager of the Colmar (Pa.) plant of Link-Belt Co. to succeed Mr. Hartman.

WILLIAM R. MOGG has been appointed general manager of the SPRING DIVISION, CRUCIBLE STEEL COMPANY OF AMERICA, Pittsburgh, Pa. He succeeds T. T. CROWLEY, who has been named vice-president and general manager of Crucible Steel of Canada, Ltd.

LEBANON STEEL FOUNDRY, Lebanon, Pa., announced the appointment of WALTER H. FLYNN as general sales manager. Mr. Flynn succeeds JOHN H. BOYD, who has resigned.

PETER H. FRATANGELO has been appointed chief engineer of E. W. BLISS CO.'s Mackintosh-Hemphill Division, Pittsburgh, Pa.

W. E. MONTGOMERY has been promoted by FIRTH STERLING INC., Pittsburgh, Pa., to chief engineer, carbide division.

THE NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION is moving its headquarters from Cleveland to Washington on September 1, it was announced today by Ludlow King, executive vice-president of the association. The new quarters are located in a newly constructed, three-story building at 2139 Wisconsin Ave., N.W., Washington 7, D.C. The 7500 square feet occupied by the Association have been laid out to meet its specific requirements. The Association is comprised of some 180 machine tool building companies, producing approximately 90 per cent of the nation's output of machine tools.

Germany

A. "ACE" VETTER has been named manager of overseas operations for THE CROSS CO., Detroit, Mich. He will begin operations for Cross' new German plant. Born and educated in Germany, Mr. Vetter began his career with the Mercedes-Benz organization in Stuttgart. Since coming to the United States in 1931, he has been associated with the machine tool industry.

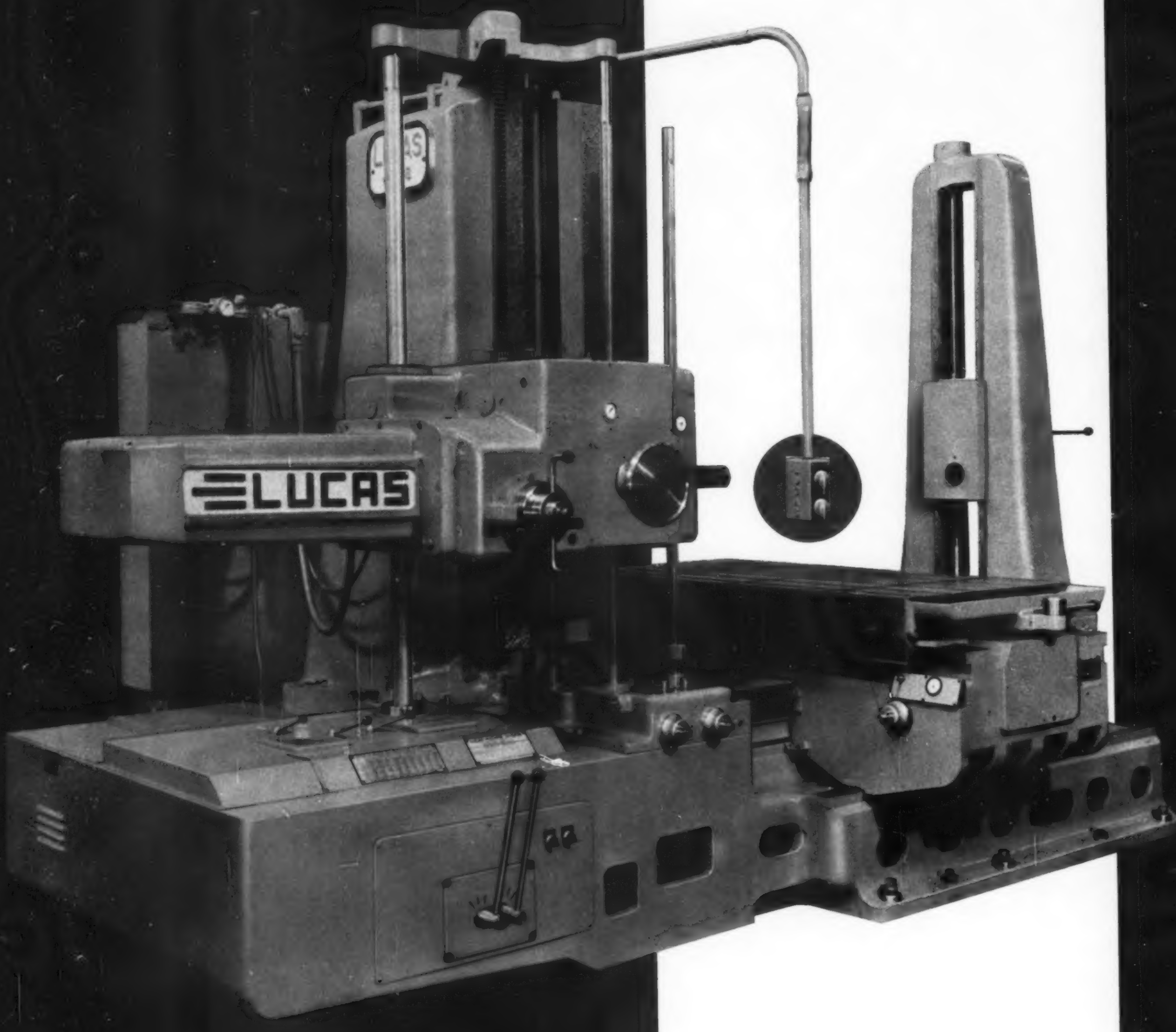
Obituary

WILLIAM H. GALLMEYER, aged seventy-six, president and treasurer of Gallmeyer & Livingston Co., Grand Rapids, Mich., died on July 25. He had been president since 1948, succeeding his brother, Charles H. Gallmeyer, who headed the firm from 1932 to 1948. His father, Christian Gallmeyer, was president from the founding of the company until 1932. Mr. Gallmeyer was a member of other business and civic organizations in his community.

Coming Events

OCTOBER 20-22–Sixth Annual Conference on Lubrication, jointly sponsored by the American Society of Lubrication Engineers and the American Society of Mechanical Engineers, will be held at the Sheraton-McAlpin Hotel in New York City. For additional information write to the American Society of Lubrication Engineers, 5 N. Wabash Ave., Chicago 2, Ill.

NOVEMBER 2-6–Forty-First National Metal Exposition and Congress to be held at the International Amphitheatre, Chicago, Ill. It is under the management of the American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio; Chester L. Wells, director.


LUCAS

Lundberg cuts costs 11% by switching to Timken® hot-rolled seamless steel tubing on National Acme screw machines

TO cut costs, Lundberg Screw Products Company of Lansing, Michigan, investigated the possibility of using hot-rolled tubing on its National Acme screw machines. The question: were hot rolled tolerances adaptable to standard collets.

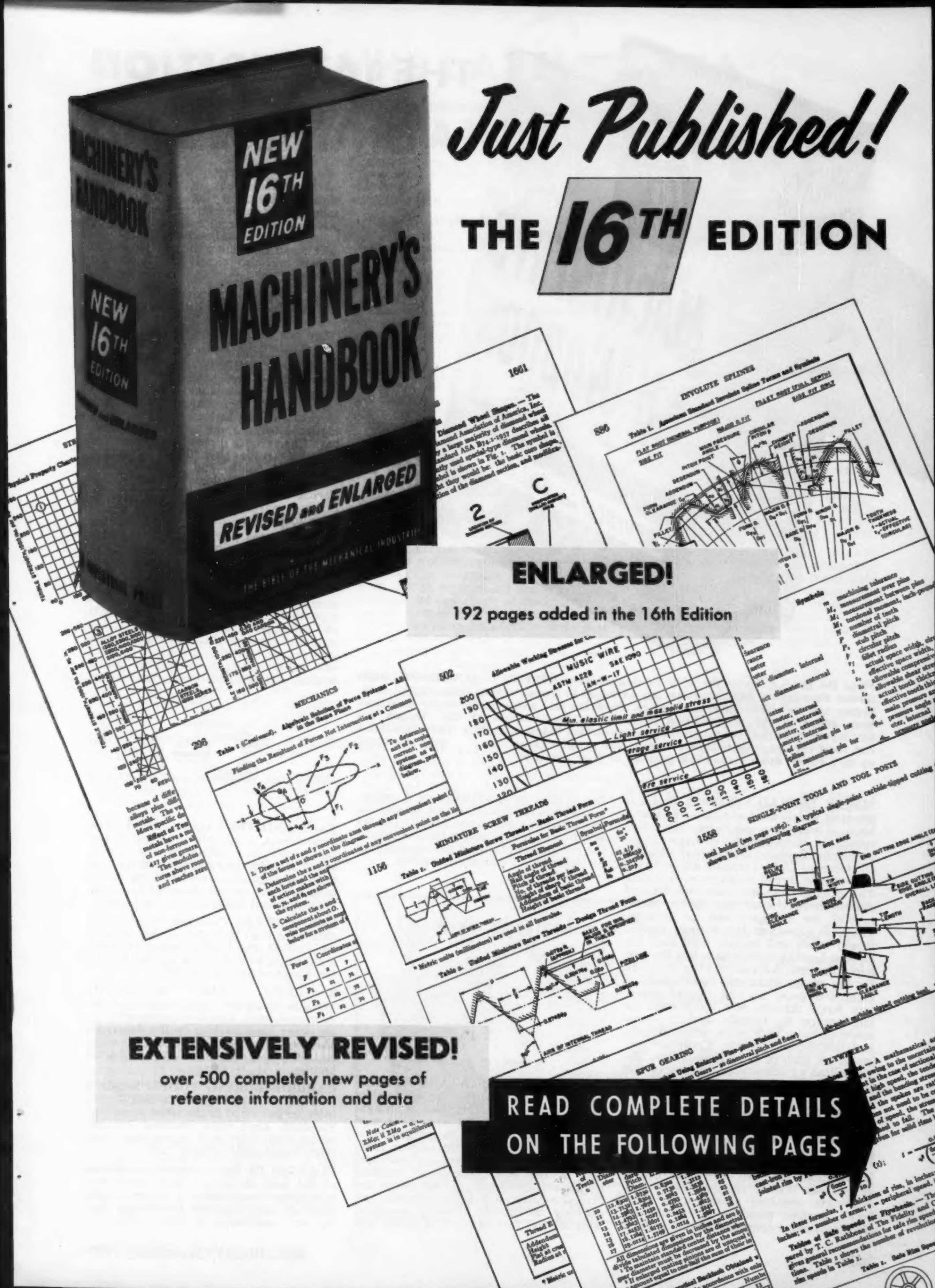
Timken Company sales engineers suggested they try hand chucking. Although hand chucking would mean a slight increase in time due to minor adjustments of collet tension, the material savings would more than offset the higher labor cost. And it did. The manufacturer found these adjustments added 1/10 of an hour per tube to production time. *But* the saving in material cost was *11%*.

Can hot-rolled Timken® seamless steel tubing save money for you? Call us and see. And to further increase your steel savings, ask Timken Company engineers to recommend the most economical tube size for your hollow parts job. We'll guarantee this size to clean up to your dimensions. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO". Makers of tapered roller bearings, fine alloy steels and removable rock bits.

Timken alloy steel and seamless tubing is available from warehouse stock in 44 cities in the United States. Call your local Timken Company sales office for the name of your nearest Timken steel distributor.

TIMKEN® *Fine Alloy* STEEL

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING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192 pages added in the 16th Edition
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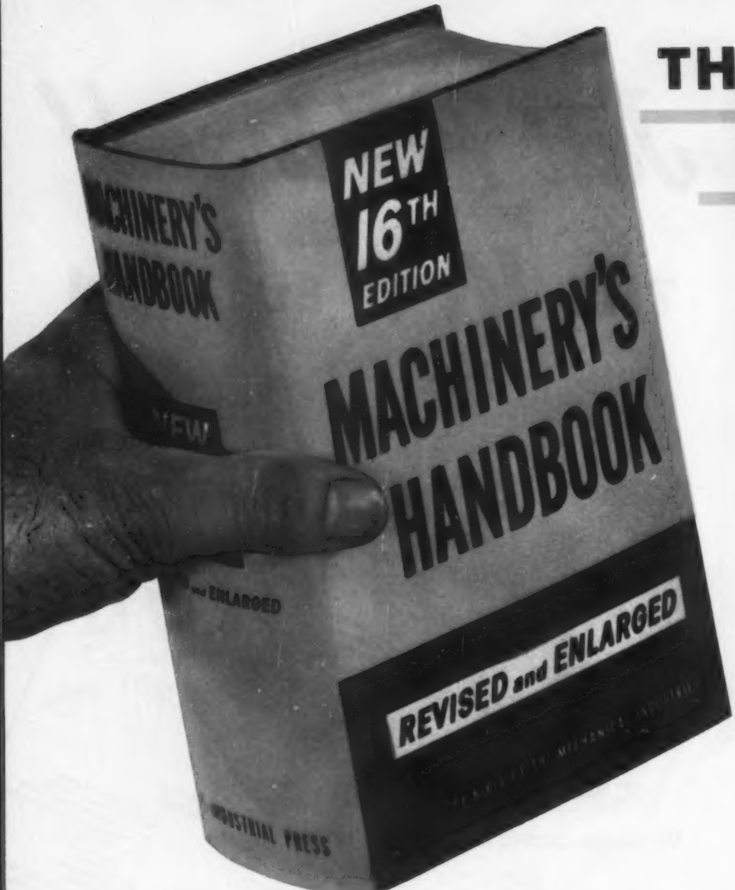


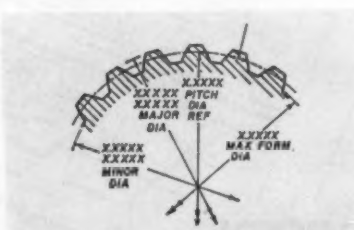
THE 16TH EDITION

ON THESE AND

Since the publication of the 15th Edition of MACHINERY'S HANDBOOK, widespread time-saving and money-saving advances in metalworking technologies, techniques and standards have taken place. Here are just some of the topics that have been added to the 16th Edition to help you keep abreast of the changes and developments in the ever-progressing metalworking industry. Only a NEW Handbook can meet the needs of today's designing and metalworking jobs . . . help *you* move up to a better, more responsible position in your industry.

SCREW THREAD SYSTEMS. Probably the most widely used section in the Handbook, it has been completely revised to reflect the latest changes in screw thread standards. Contains dimensional data for all classes of Unified threads including the several new thread series recently added. The extensive tabular data and detailed discussion of Unified threads are useful to both the machinist and the designer. These tables present data for new Unified thread series and include hole sizes for tapping Unified threads based on the new minor diameter tolerances. Data are given for the manufacture and specification of Unified threads, the new Unified miniature screw threads, new dimensions for interference fit threads (studs), Acme screw threads, Stub Acme screw threads, and microscope threads. Complete diagrams for each of these threads show the disposition of allowances, tolerances and crest clearances.

GEARING. The subject of gearing has always been given careful attention in MACHINERY'S HANDBOOK. Advances in fine-pitch precision gearing called for the inclusion of this kind of detailed information: enlarged spur and helical gears from 7 teeth up, composite error inspection, checking pressures, indicator limits, angular position errors, angular blacklash, and a complete tabular description of data for specification on drawings. . . . This is the first handbook to give the *exact* formula and tables of data for the selection of helical gear milling cutters in the production of milled gears for experimental and replacement purposes.

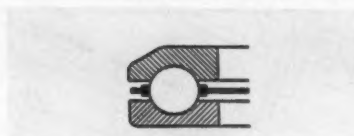


INVOLUTE SPLINES AND SERRATIONS. The widespread use of involute splines and serrations in place of straight splines has necessitated a new 43-page section giving complete design data, formulas, and dimensions in tabular form for the design, production, and specification of the various types of involute splines and serrations. As an aid to the draftsman, several pages are devoted exclusively to detailed drawing specifications for the various types of spline and serration fits. Tables of wire sizes and wire measurement data for involute splines and involute serrations are also included. The effect of spline errors on spline fits, error allowances and tolerances, and machining data pertaining to splines are also clearly explained and illustrated.

TWIST DRILLS. Included in this section are data on combined drills and countersinks, jobbers length millimeter drills, and other new data from the revised American Standard for twist drills.

PHYSICAL PROPERTIES OF STEELS. Heat-treated steels have been found to have the same tensile and yield strengths regardless of composition and alloying elements so long as they have been fully hardened to the same as-quenched hardness. Charts make it possible to determine expected tensile strength, reduction in area, yield points, and tempering temperature if the hardness of a particular steel is known. Strength data for a wide range of ferrous and non-ferrous metals are also given.

BALL, ROLLER, AND NEEDLE BEARINGS. This 72-page section gives standard description and dimensional data for all types of ball, roller and needle bearings. Besides dimensional and tolerance data for inch and metric bearings, there are data pertaining to shaft and housing fits, clamping and retaining methods, bearing life, radial and thrust load ratings, selection procedure for ball and roller bearings, equipment loads, bearing capacity, and bearing lubrication.



TAPS AND THREADING DIES. New designations, applicable to ground thread taps, have been added to this section which includes dimensions of all types of taps and dies. Recommended tap limits to achieve the various classes of fits in the Unified thread series are also included.

TAP DRILLS. Complete dimensional data have been included on drilled holes for Unified and Unified miniature internal threads, as well as for the old American Standard thread classes.

KNURLING AND KNURLING TOOLS. Complete data concerning the diametral pitch knurls recommended as providing good tracking by the American Standard are presented. Includes tolerances for work diameters before and after knurling.

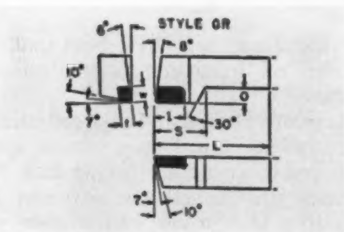
CARBIDE BORING TOOLS. Standard data for solid and tipped carbide boring tools, as published in the latest American Standard, have been included because boring tools differ in many respects from other single-point cutting tools.

FLAT BELTS. The continuing popularity of flat belts in certain applications has been given consideration in 16 new pages, complete with diagrams for cutting, lacing and installation of these belts.

GIVES YOU THE LATEST DATA

OTHER IMPORTANT SUBJECTS!

SINGLE-POINT CUTTING TOOLS. Added to this section are data on solid carbide inserts and their holders, with complete dimensions for each. These are the carbide cutting tools included in the latest American Standard.



SELF-TAPPING SCREWS. Data on drills and punched holes for self-tapping screws and the application of the various types of screws are presented.

TAPERS. Data on Morse stub taper shanks have been added to the already extensive taper-shank section of the Handbook.

SCREW THREAD INSERTS. Screw thread inserts including the self-tapping type are now widely used to achieve strong threads in soft materials, as well as for replacement of stripped threads.

TAPER PINS. To facilitate the machining of taper holes for taper pins a new chart has been provided showing drill sizes for step drilling prior to taper reaming.

GROOVED PINS. Dimensions of standard grooved pins have been given.

BOLTS, SCREWS, NUTS, WASHERS. Among the changes in this section are new American Standard dimensions for plain washers and toothed lock washers and clearances for box, open-end, and socket wrenches.

GRINDING, POLISHING, AND LAPPING. This new 54-page section provides the latest in available data, techniques, and process descriptions in connection with grinding wheels, wheel dressing, centerless-, surface-, cylindrical-, offhand- and portable-grinding. Tables of grinding troubles give recommendations for their correction. Descriptive data facilitate the selection of proper grinding wheels.

METAL JOINING, CUTTING AND SURFACING. This completely new 36-page section deals with soldering, brazing, hard facing, welding, flame cutting, arc-cutting, etc. In addition to detailed descriptions of each of these processes, convenient tables aid in the selection of the best process for the operation at hand. Explains brazing of high-speed steel tips to carbon steel shanks.

V-BELTS AND SHEAVES. The increasing use of V-belt drives is reflected in the new 17-page section dealing with such topics as: light-duty drives, belt cross-sections, sheave dimensions, horsepower ratings, multiple V-belts, V-belt installation, service factors, operating speeds, idlers, V-flat drives, double-angle V-belts, and selection procedure.

TRANSMISSION CHAINS. A section of 41 pages provides coverage of transmission roller chains and silent chains. Discussed are: sprockets, chain parts, keys, keyways, set-screws, center distance between sprockets, length of chain, cutting sprocket tooth form, sprocket materials, cutters for sprocket teeth, horsepower ratings, design procedure, chain designations and dimensions, drive ratios, chain selection, etc.

FLYWHEELS. Because the flywheel is so important as a source of energy for punching, shearing and other shop operations as well as a means of providing a uniform flow of energy in rotating engines, new data pertaining to the design of flywheels are given. This takes account of centrifugal stresses, combined stresses, and residual stresses. Of primary importance are the two up-to-date tables of safe speeds for flywheels in accordance with American Standard and insurance company requirements.

STRENGTH OF MATERIALS. The data given on the strength of materials, or mechanics of materials, take the guesswork out of determining the most economical size and shape of machine parts or structures to meet strength and deflection requirements. In addition to formulas and data that apply to straight beams and columns, new sections have been added, giving formulas and tables for curved beams such as are used in machine frames; pipe columns; round, rectangular, and square plates; cylinders subjected to internal and external pressure; tubes, and shells.

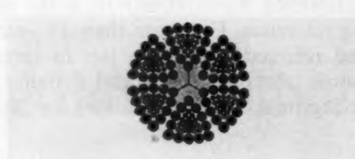
SHAFTS. Formulas and directly applicable tables for strength and horsepower capacity, as well as considerations of torsional and linear deflection for various conditions of loading, are given in detail. Included are formulas for critical speeds of rotating shafts, formulas for shafts of brittle materials, and data for the effect of keyways on shaft strength.

STANDARDS. Data and information from the latest American Standards have been included, wherever possible throughout the wide range of Handbook topics. Comparable data and information from a large number of British Standards have also been given to provide a reliable reference on British practice.

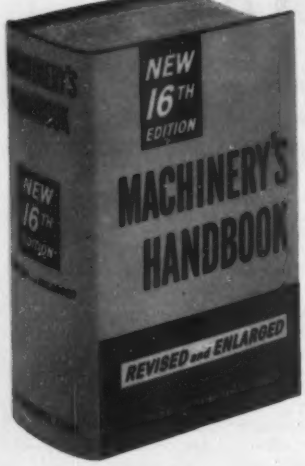
SPRINGS. The data for designing and winding springs have been supplemented by a new section giving a detailed description of the most widely used spring materials, their strengths, moduli of elasticity, service factors for various applications, endurance limits, and working stresses at elevated temperatures.

PLAIN BEARINGS. A complete section on the factors to be considered in the design and selection of plain bearings, as well as a step-by-step procedure utilizing simple charts and formulas, has been provided as a guide for the designer. In addition to complete tables of alloys for both solid and sintered bearings, information on wood bearings, plastic laminate bearings, rubber bearings and others is given and the procedure for babbitting bearings in the shop is explained in detail.

INVOLUTE FUNCTIONS. Involute functions of angles have been established as the most convenient means for solving certain problems in gear design and measurement. A complete set of involute functions from 14 to 58 degrees in increments of one minute and to as many as seven decimal places is provided.



WIRE ROPE. Some of the topics covered in this new 17-page section are: installation, safe working loads, factors of safety, sizes, simplified practice recommendations, drum and reel capacities, maintenance, lubrication, replacement.



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Metalworking and Design Handbook You Can Own

Whether you are a supervisor, foreman, inspector, toolmaker, machinist, student, or apprentice, you need an accurate, easy-to-use, up-to-date source of specific metalworking information.

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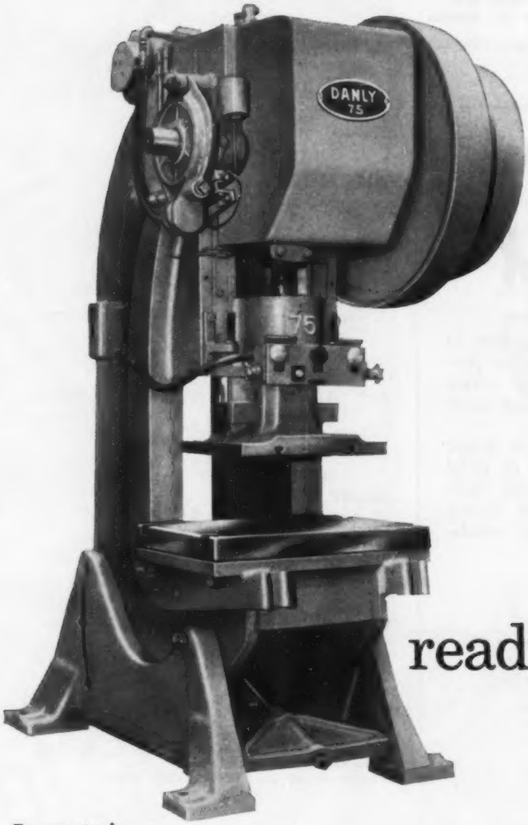

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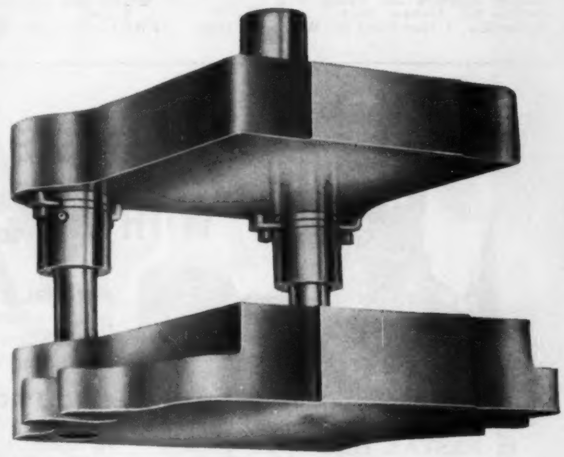

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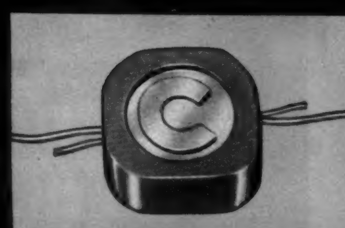

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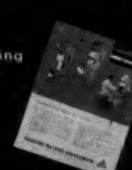

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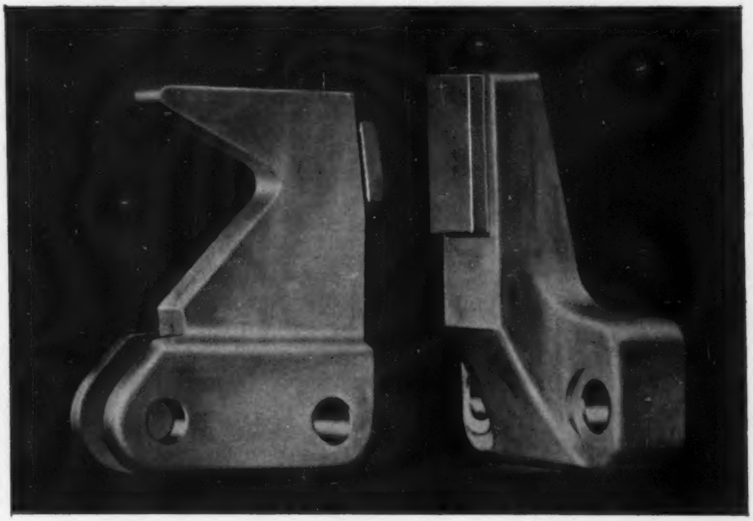
(Continued on page 250)

TWICE-WROUGHT METAL

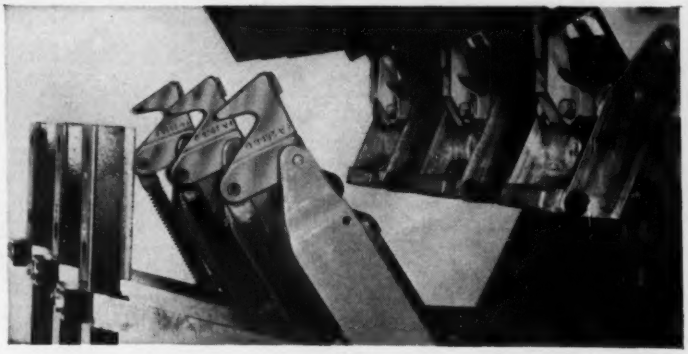
of die-pressed forgings helps Federal Pacific make new air circuit breakers more rugged—cuts machining costs in half

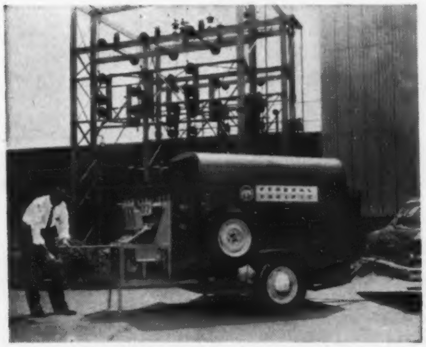


In its new Type DST magnetic air circuit breaker line, Federal Pacific Electric Company, Newark, N. J., builds in dependable operation and long life with parts of outstanding mechanical and adequate electrical properties.

Typical of this attention to detail are the arcing contacts (left). Similar parts previously used had been castings or built-up assemblies. Now the contact bodies are Anaconda Forging Brass-250 die-pressed forgings. The twice-wrought metal is denser, stronger, withstands mechanical shock better—reducing the fatigue factor and producing longer service life. The contacts also have higher conductivity. And best of all, their consistent dimensional accuracy and smooth finish cut machining costs in half.

RIGHT: Movable arcing contact assemblies at the left and the stationary arcing contact assemblies at the right in a 5-kv Federal Pacific Type DST air circuit breaker. They have a momentary current-carrying capacity of 60,000 amperes. Contact tips of tungsten alloy are silver-soldered to the forgings. These are two of several areas where Federal Pacific uses the superior physical properties of Anaconda die-pressed forgings to help provide dependable operation and long service life in its line of metal-clad switchgear.





Federal Pacific takes its circuit breakers out to industrial and electric utility customers. Here a representative sets up a demonstration of a 5-kv, 1,200-amp breaker in the field.

It is often easier than you think to achieve high quality and performance while simplifying fabrication and cutting over-all costs. American Brass technical specialists are constantly working with designers, production engineers and buyers, helping them meet their joint requirements—through the use of such Anaconda mill products as die-pressed forgings, extruded shapes, special-shape tubes. For this kind of practical help, see your American Brass representative or write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Toronto 14, Ontario. 5944

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Cincinnati Milling & Grinding Mchs., Inc., Cincinnati, Ohio.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

BRONZE
American Brass Co., Waterbury 20, Conn.
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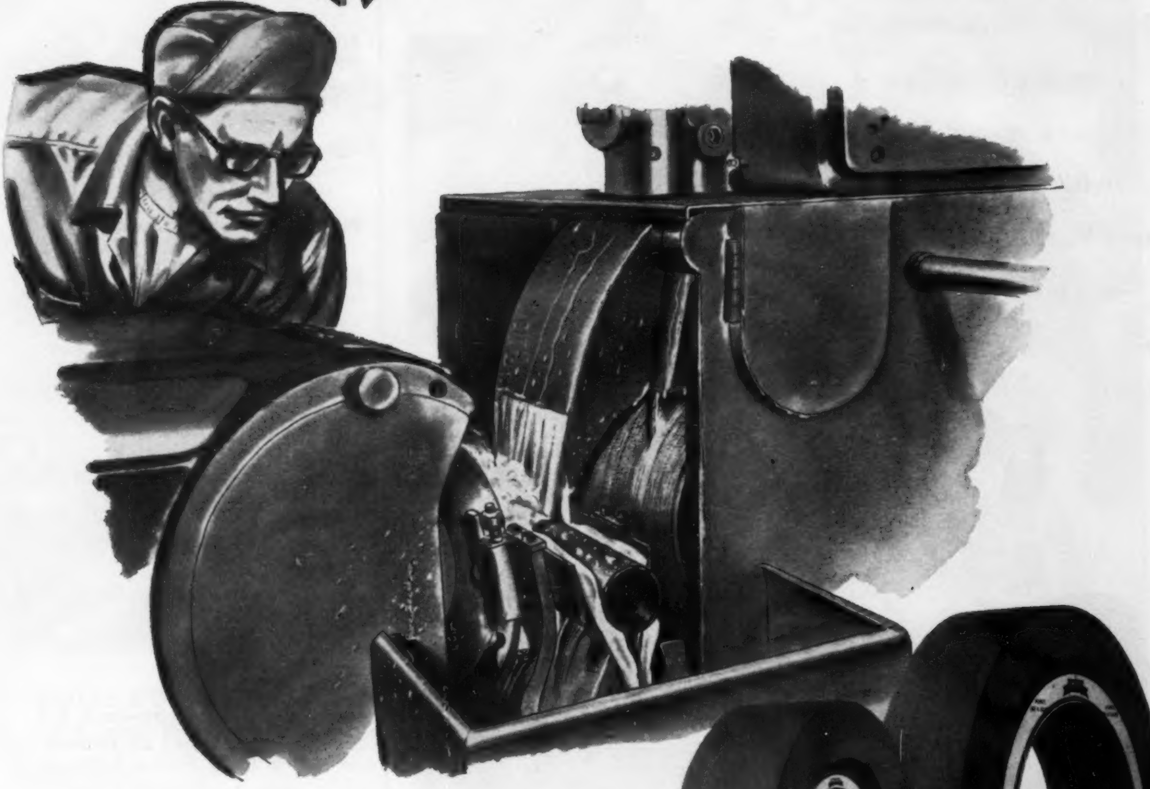

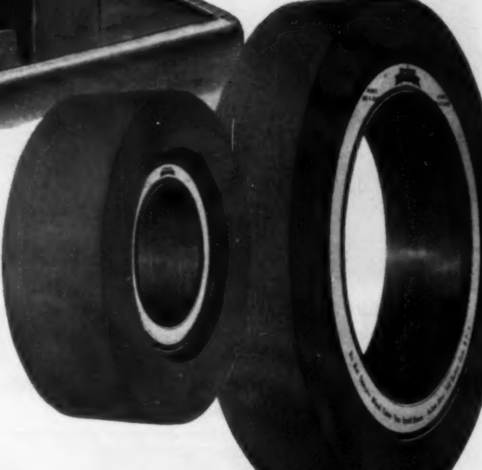

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BRUSHES, Industrial, Tampico, Wire Wheel, Etc.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, Ohio.

BUFFERS
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Standard Electrical Tool Co., 2488 River Rd., Cincinnati, Ohio

BULLDOZERS, Metalforming
Birdsboro, Steel Foundry & Machine Co., Birdsboro, Pa.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio.
Erie Foundry Co., 1253 W. 12th St., Erie. Penna.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

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Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.

BURRING MACHINES—See Deburring Machines

BURRS—See Files and Burrs, Rotary

BUSHINGS, Drill Jig
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Hardened Steel
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Non-ferrous and Powdered Metal
Bunting Brass & Bronze Co., 715 Spencer, Toledo Ohio.
Universal Engrg. Co., Frankenmuth, Mich.

CALIPERS, Spring, Firm-Joint, Transfer, Hermaphrodite, etc.—See Layout and Drafting Tools, Machinists' Small Tools

CALIPERS, Vernier
Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

CAM CUTTING MACHINES
Cincinnati Milling & Grinding Mchs., Inc., Cincinnati 9, Ohio.
Cosa Corp., 405 Lexington Ave., New York, 17, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

CAMERAS, High Speed
Wollensak Optical Co., Rochester 21, N. Y.

CAM MILLING AND GRINDING MACHINES
American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Landis Tool Co., Waynesboro, Pa.
Rowbottom Machine Co., Waterbury, Conn.

CAMS
Brown & Sharpe Mfg. Co., Providence, R. I.
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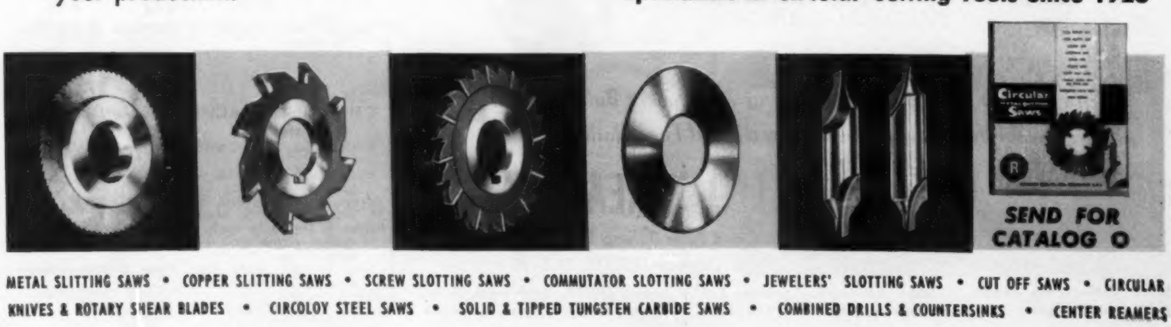

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CARBIDES
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
DoALL Co., Des Plaines, Ill.
Kennametal, Inc., Latrobe, Penna.
Linde Co., 30 E. 42nd St., New York 17, N. Y.
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

CASTINGS, Die
American Brass Co., Waterbury 20, Conn.
Madison-Kipp Corp., Madison, Wis.

CASTINGS, Non-ferrous
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Shenango Furnace Co., Dover, Ohio.
Textile Machine Works, Reading, Penna.
Vascoloy-Ramet Corp., Waukegan, Ill.

CASTINGS—Gray Iron, Malleable
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Malleable Castings Council, 1800 Union Commerce Bldg., Cleveland 14, Ohio.
Shenango Furnace Co., Dover, Ohio.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Textile Machine Works, Reading, Penna.

CASTINGS, Steel, Stainless, etc.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.
Jessop Steel Co., Washington, Penna.

CENTER-DRILLING MACHINES
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

CENTER PUNCHES—See Machinists' Small Tools

CENTERS, Grinding Machines, Indexing Head and Lathe
DoAll Co., Des Plaines, Ill.
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

CERAMIC TOOL MATERIAL—See Tool Material, Ceramic

CHAINS, Power Transmission and Conveyor
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.

CHUCKING MACHINES, Multiple-Spindle Automatic
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Goss & DeLeeuw Mch. Co., Kensington, Conn.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.

(Continued on page 256)

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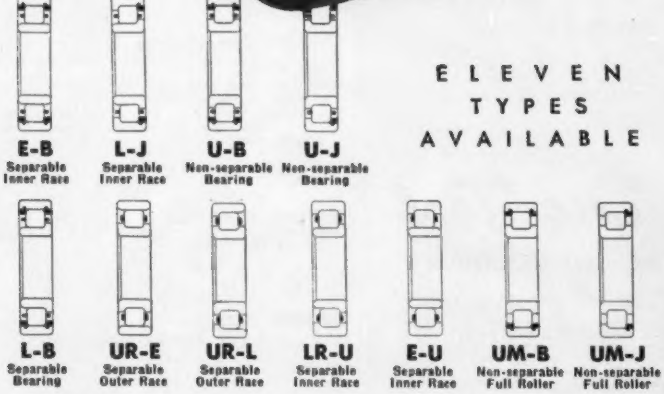

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Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Potter & Johnston Co., 1027 Newport Ave., Pawtucket, R. I.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 83, Ohio.

CHUCKS, Air Operated
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Schrader's Son, A., 470 Vanderbilt Avenue, Brooklyn, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Collet
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jacobs Mfg. Co., West Hartford 10, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio.
Universal Engrg. Co., Frankenmuth 2, Mich.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

CHUCKS, Combination Universal-Independent
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Gisholt Mch. Co., Madison, 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
L-W Chuck Co., Toledo 4, Ohio
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Compensating
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Diaphragm
Woodworth, N. A. Co., 1300 E. Nine Mile Rd., Detroit 20, Mich.

CHUCKS, Drill, Key Type
Jacobs Mfg. Co., West Hartford, Conn.

CHUCKS, Drill, Keyless
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37 N. Y.
Jacobs Mfg. Co., West Hartford, Conn.

CHUCKS, Full Floating

Gisholt Mch. Co., Madison 10, Wis
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.
Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Gear

Buck Tool Co., 2015 Schippers Lane, Kalamazoo Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.

CHUCKS, Independent

Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Lathe

Bullard Co., Brewster St., Bridgeport 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Jacobs Mfg. Co., West Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Magnetic

Brown & Sharpe Mfg. Co., Providence, R. I.
Hanchett Magna-Lock Corp., Big Rapids, Mich.
L-W Chuck Co., Toledo 4, Ohio.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Walker, O. S. Inc., Worcester, Mass.

CHUCKS, Power Operated

Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Gisholt Mch. Co., Madison 10, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Quick Change and Safety

Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Jacobs Mfg. Co., West Hartford 10, Conn.
Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Ring Wheel

Gardner Mch. Co., 414 E. Gardner St., Beloit Wis.

CHUCKS, Tapping

Jacobs Mfg. Co., West Hartford, Conn.
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.

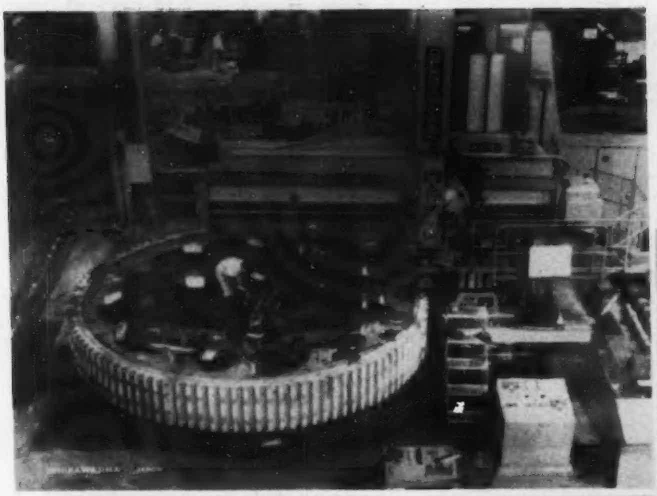
CHUCKS, Universal Three-Jaw

Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
L-W Chuck Co., Toledo 4, Ohio
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

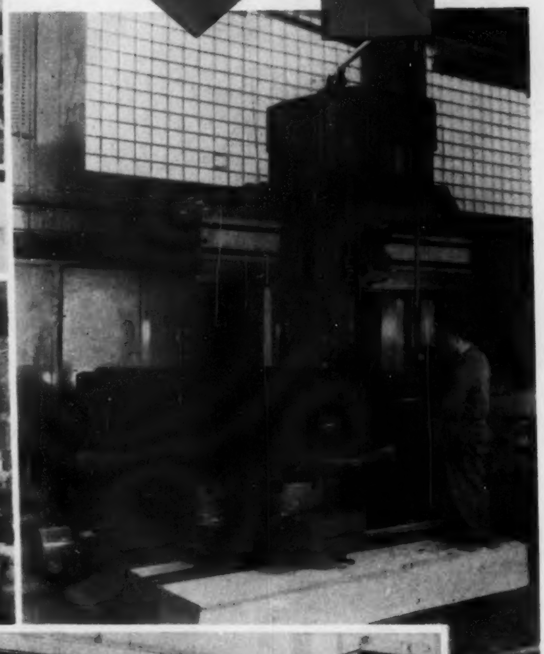
CHUCKS, Wrenchless

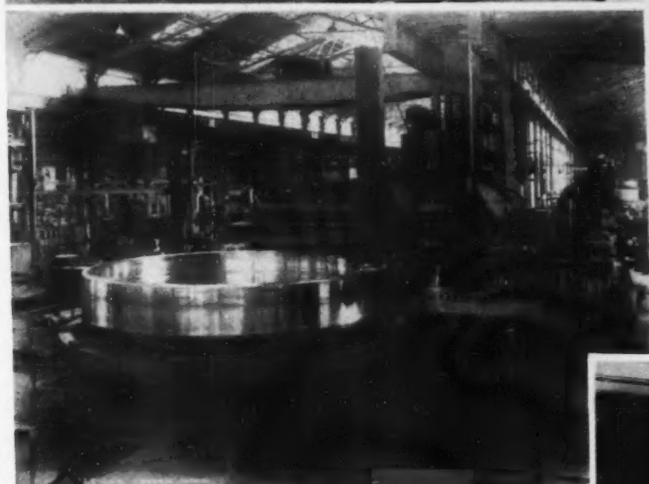
Gisholt Mch. Co., Madison 10, Wis.

CLAMPS, "C", Toggle, Toolmakers' Parallel—See Set-Up Equipment

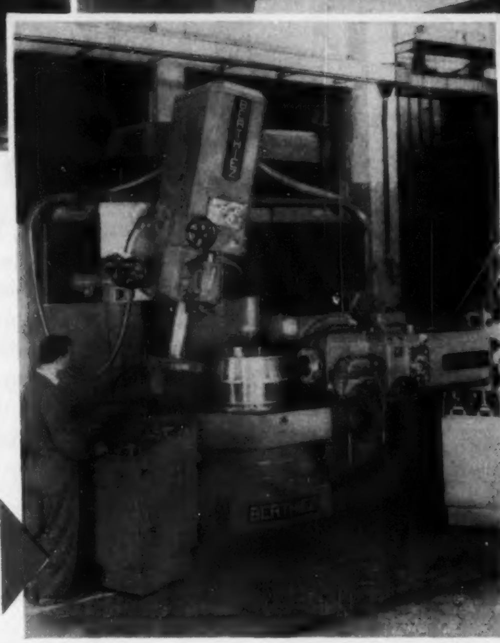


Vertical Boring and Turning Mill
type BML 180





Vertical Boring and Turning Mill
type 9375



Vertical Chucking Grinder type 1009

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Minster Mch. Co., Minster, Ohio.

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COLLETS—See Chucks, Collet

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Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 883, Dayton 1, Ohio.

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Eastman Kodak Co., Rochester, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Opto-Metric Tools, Inc., 137 Varick St., New York 13, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

COMPOUNDS, Cleaning—See Cleaners, Metal

COMPOUNDS, Cuttings, Grinding, Metal Drawing, etc.—See Cutting and Grinding Fluids

COMPRESSORS, Air
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Wilson, K. R., Inc., Arcade, N. Y.

CONTOUR FOLLOWER—See Tracing Attachments

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Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
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Wesson Co., 1200 Woodward Heights Blvd., Detroit 20, Mich.

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Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
James, D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
Mueller Brass Co., Port Huron, Mich.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
Walker Co., Inc., O. S., Rockdale St., Worcester, Mass.

CRANES, Electric Traveling
Cleveland Crane & Engrg. Co., Wickliffe, Ohio.

CUTTERS, Keyseating
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
DoALL Co., Des Plaines, Ill.
Mitts & Merrill, 1009 So. Water St., Saginaw, Mich.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill (end mills).
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
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Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Kennametal, Inc., Latrobe, Penna.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio.
Tomkins-Johnson Co., Jackson, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

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Oakite Products, Inc., 26 Rector St., New York 6, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Sinclair Refining Co., 600 Fifth Ave., New York, N. Y.
Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St., Chicago 23, Ill.
Texaco, Inc., 135 E. 42nd St. New York 17, N. Y.

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Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Tomkins-Johnson Co., Jackson, Mich.
Wilson, K. R., Inc., Arcade, N. Y.

CYLINDERS, Hydraulic
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Chicago Pneumatic Tool Co., New York 17, N. Y.
Hannifin Co.,., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Logansport Machine Co., Inc., Logansport, Ind.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.
Wilson, K. R., Inc., Arcade, N. Y.

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Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, Ohio.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

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Blanchard Mch. Co., 64 State St., Cambridge, Mass.

DIE CASTINGS—See Casting, Die

DIE CASTING MACHINES
B & T Machinery Co., Rockford, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio.

DIE CUSHIONS
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Minster Machine Co., Minster, Ohio.
Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave., Chicago, Ill.

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Kennametal, Inc., Latrobe, Penna.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.

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Cratex Mfg. Co., Inc., Burlingame, Calif.
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Lempco Industrial, Inc., Bedford, Ohio.
Producto Mch. Co., 985 Housatonic Ave., Bridgeport 1, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
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DIE SINKING MACHINES—See Milling Machines, Die Sinking, etc.

DIE STOCKS—See Stocks and Dies

NOW 7* STANDARD LAPMASTERS

MODEL 10 for maintenance lapping of parts up to 3-11/16" dia.

FOR PRECISION LAPPING

to a flatness of .0000116" or less with a micro-inch finish of 2 to 3 RMS. All Lapmasters will maintain this uniform accuracy piece-after-piece because conditioning rings continually condition the lap plate during entire lapping cycle.

IN SMALL LOTS OR THOUSANDS PER DAY

with consistent accuracy. Production is not interrupted or slowed down for replacing or reconditioning lap plates.

MODEL 12 for parts up to 4" dia.

OF PARTS UP TO 32" DIA.

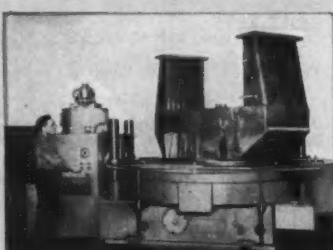
and as small as ⅛" dia. Accurately laps paper-thin pieces as well as giant two-ton parts.

OF ANY SHAPE, FORM OR MATERIAL

tall or squat, long or short, flat or odd shaped . . . any metal, ceramics or plastic all at the same time if necessary. Inexpensive work holders eliminate danger of stresses and warping usually caused by clamping during grinding or milling.

*For your special lapping requirements, we will build Lapmasters any size.

MODEL 24 for parts up to 9½" dia.



MODEL 84 for parts up to 32" dia.

MODEL 72 for parts up to 27" dia.

MODEL 36 for parts up to 13¾" dia.

WRITE FOR THE COMPLETE LAPMASTER STORY

Write for bulletins describing the Lapmaster line and chart on measuring flatness.

MODEL 48 for parts up to 17" dia.

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Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport 7, Conn.
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Olofsson Corp., Lansing, Mich.
Ryerson & Son, Inc., Jos. T., 16th & Rockwell St., Chicago 8, Ill.
Vascoloy-Ramet Corp., Waukegan, Ill.
Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave, Chicago, Ill.
Wales-Strippit, Inc., Akron, N. Y.

DIES, Lettering and Embossing
Wales-Strippit, Inc., Akron, N. Y.

DIES, Self-opening Threading
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Mch Co., Springfield, Vt.
Landis Mch Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.

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DIES, Thread Rolling
Landis Machine Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio.

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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Elox Corp. of Michigan, Troy, Mich.

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DIVIDING HEADS—See Indexing and Spacing Equipment

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Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Producto Machine Co., 985 Housatonic Ave., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

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Oakite Products Inc., 26 Rector St., New York 6, N. Y.
Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St., Chicago 23, Ill.

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Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
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Norton Co., 1 New Bond St.. Worcester, Mass.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio.

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DoALL Co., Des Plaines, Ill.

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Baush Machine Tool Co., 15 Watson Ave., Springfield 1, Mass.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Jarvis Corp., Middletown, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Richmond, Ind.
Snyder Corp., 3400 E. Fafayette Ave., Detroit 7, Mich.
Thriftmaster Products Corp., 1076 N. Plum St., Lancaster, Pa.
United States Drill Head Co., 616 Burns, Cincinnati, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

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Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Kingsbury Mch. Tool Corp, Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Snow Manufacturing Co., Bellwood, Illinois.

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DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Automatic Tool Co., Inc., S. 7th & N Sts., Richmond, Ind.

DRILLING ATTACHMENTS, Multiple Spindle—See Drill Heads, Multiple Spindle, and Vises, Machine

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Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Ettco Tool Co. Inc., 594 Johnson Ave, Brooklyn 37, N. Y.
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Kearney & Trecker Corp., 6784 W. National, Milwauke 14, Wis.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Townsend, H. P. Mfg. Co., Elmwood, Conn.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

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Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
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Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Davis & Thompson Co., 4460 N. 12th St., Milwaukee 10, Wis.
Edlund Mchry. Co., Div., Cortland, N. Y.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Olofsson Corp., Lansing, Mich.
Snow Manufacturing Co., Bellwood, Ill.
Wales-Strippit, Inc., Akron, N. Y.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

DRILLING MACHINES, Bench

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Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio.
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Edlund Machinery Co., Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Hamilton Tool Co., 834 9th St., Hamilton, Ohio.
Homestrand, Inc., Larchmont, N. Y.
Leland-Gifford Co., Box 989, Worcester, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.

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Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Berthiez, Charles, 5 Rue Montalivet, Paris, France.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Wales-Strippit, Inc., Akron, N. Y.

DRILLING MACHINES, Gang, Multiple-spindle

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Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 4460 124th St., Milwaukee 10, Wis.
Edlund Machinery Co., Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Greenlee Bros. & Co., 136 12th St., Rockford, Ill.
Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio.
Homestrand, Inc., Larchmont, N. Y.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., Box 989, Worcester, Mass.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

For more data, circle this page number on inquiry card

DRILLING MACHINES, Radial
American Tool Works Co., Pearl & Eggleston Ave., Cincinnati, Ohio.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio.
Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio.
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Homestrand, Inc., Larchmont, N. Y.

DRILLING MACHINES, Sensitive
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Burg Tool and Mfg. Co., Inc., 15001 S. Figuera, Gardena, Calif.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio.
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Cincinnati 9, Ohio.
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Edlund Machinery Co. Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, St., Cincinnati 23, Ohio.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio.
Leland-Gifford Co., Box 989, Worcester, Mass.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Snow Manufacturing Co., Bellwood, Illinois.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Wales-Strippit, Inc., Akron, N. Y.

DRILLING MACHINES, Universal Radial
Kaukaua Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.

DRILLING MACHINES, Upright
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Barnes, W. F. & John Co., Rockford, Ill.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Homestrand, Inc., Larchmont, N. Y.
Ingersoll Milling Mch. Co., 2442 Douglas St.,
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Rehnberg-Jacobson Mfg. Co., 2135 Kishwaukee St., Rockford, Ill.
Snow Manufacturing Co., Bellwood, Ill.
Wales-Strippit, Inc., Akron, N. Y.

DRILLS, Center
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Circular Tool Co., 765 Allens Ave., Providence 5, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
Cogsdill Twist Drill Co., Greenfield, Mass.
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

DRILLS, Core
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Greenfield Tap & Die Corp., Greenfield, Mass.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
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PRODUCTION. *Larger grinding wheel, more horsepower, non-swivelling wheelhead, 8-speed headstock.*

PLUNGE. *Similar to production type but with axially oscillating wheelhead and hand table control only.*

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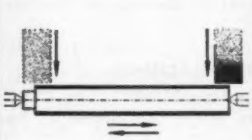
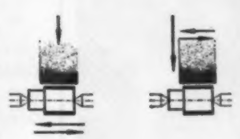
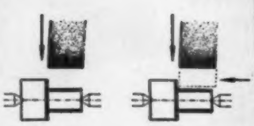
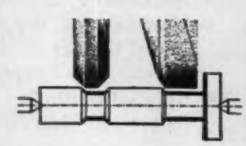
10", 12", 14", and 18" swings (with choice of lengths between centers).

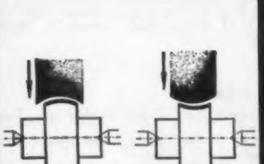
Model R4-500 U shown at left. Universal type, 10" swing, 24" center distance.











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- *Infinitely variable hydraulically controlled table speeds*
- *Table reversals within ± .0002" as short as 1/16"*
- *Table dwell 0 to 20 seconds*
- *Automatic precision infeed to .000050", right, left or both ends of traverse*
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Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.

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Chicago Pneumatic Tool Co., New York 17 N. Y.

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Chicago Pneumatic Tool Co., New York 17, N. Y.

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Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio

DRILLS, Subland
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Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Mohawk Tools, Inc., Montpelier, Ohio.

DRILLS, Twist, High-Speed Steel, Carbon Steel
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Cleveland Twist Drill Co., 1242 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield Mass.
Mohawk Tools, Inc., Montpelier, Ohio
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Twist, Carbide, Carbide-Tipped
Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoAll Co., Des Plaines, Ill.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Wire
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Cleveland Twist Drill Co., Cleveland, Ohio.
Cogsdill Twist Drill Co., Greenfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.

DUPLICATING ATTACHMENTS—See Tracing Attachments

DUST COLLECTORS AND CONTROL SYSTEMS
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Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Pangborn Corp., Hagerstown, Md.
Standard Electrical Tool Co., 2500 River Rd. Cincinnati 14, Ohio.

ELECTRICAL DISCHARGE MACHINES—See Disintegrators

ELECTRONIC CONTROL SYSTEMS
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Stromberg-Carlson Div., General Dynamics Corp., 1493 N. Goodman St. Rochester 3, N. Y.

ENGRAVING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton, Geo., Mach., 1321 Racine St., Racine, Wis.

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Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
Greenfield Tap & Die Corp., Greenfield, Mass.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

FACING HEADS
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Davis Boring Tool Div., Giddings & Lewis Mch. Tool Co., Fond du Lac. Wis.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Mummert-Dixon Co., Hanover, Pa.

FANS, Exhaust, Ventilating
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.

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Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
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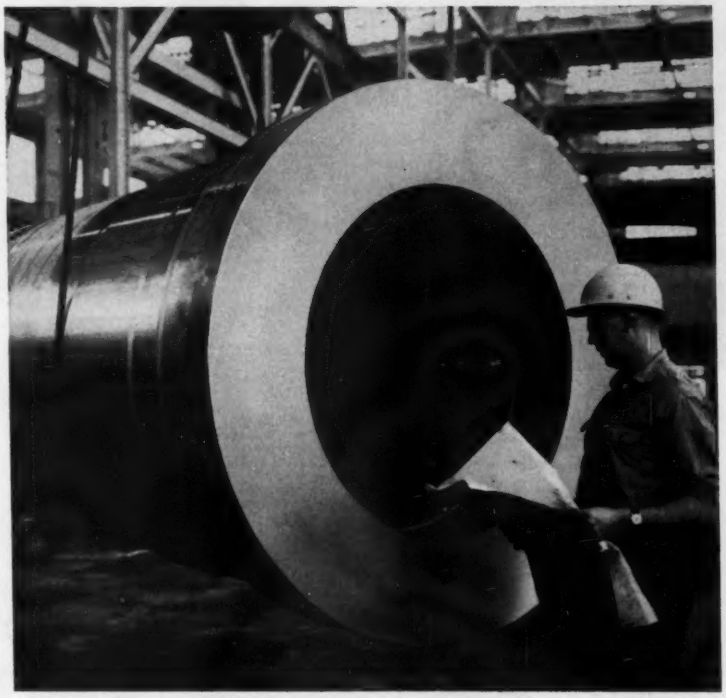
o get a big press back into action fast . . .

Bethlehem forged, rough-machined, and tested this cylinder in 6 weeks



21/59

he main high-pressure cylinder f a 2,750-ton hydraulic xtrusion press fails, and rass rod production ceases.

The owner of the press, itan Metal Manufacturing Company, ellefonte, Pa., contacts Lake rie Machinery Corporation, uffalo, N. Y., who, although hey did not make the press n question, are able to redesign nd assist in rebuilding, ince they are a leading ydraulic press manufacturer.

26/59

Lake Erie places an order for new cylinder--forged and ough-machined--with Bethlehem. pecifications call for arbon steel, treated and tested; 3 in. max OD; 42 in. bore; 33 in. overall length.

10/59

Bethlehem completes forging d machining to exact pecifications, and ships ,460-lb cylinder.

3/26/59

Lake Erie completes finish-machining, and manufacture of component parts. Cylinder is installed, and press is back in action.

You may never require as big a forging as fast. Still, it's comforting to know that if the occasion does arise, Bethlehem can handle it. Our shops can meet your specifications on all types of drop, press, and hammer forgings, regardless of size or design.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export distributor: Bethlehem Steel Export Corporation.

BETHLEHEM STEEL

FEEDERS, Automatic
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Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.

FILES, Band
DoALL Co., Des Plaines, Ill.

FILES, General-purpose, Swiss Pattern
DoALL Co., Des Plaines, Ill.

FILES AND BURRS, Rotary
DoALL Co., Des Plaines, Ill.
Jarvis Corp., Middletown, Conn.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

FILING MACHINES
Chicago Pneumatic Tool Co., New York 17, N. Y.
DoALL Co., Des Plaines, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

FILTERS, Coolant and Oil
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Cuno Engineering Corp., Meriden, Conn.
Johnson, S. C. & Son, Inc., Racine, Wis.
Marvel Engineering Co., 7227 N. Hamlin Ave., Chicago 45, Ill.

FLAME-HARDENING MACHINES
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.

FLEXIBLE SHAFT EQUIPMENT
Jarvis Corp., Middletown, Conn.

FORGING HAMMERS, Steam and Air
Chambersburg Engrg. Co., Chambersburg, Pa.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.

FORGING MACHINES, Headers, Upsetters, Presses
Ajax Mfg. Co., 1441 Chardon Rd., Cleveland 17, Ohio
Bliss, E. W. Co., 1375 Raff Rd. S. W. Canton, Ohio
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
National Machinery Co., Tiffin, Ohio
Waterbury Farrel Foundry & Mch. Co., Waterbury, Conn.

FORGING, Hollow-Bored
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.

FORGINGS, Drop
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.
Wyman-Gordon Co., Worcester, Mass.

FORGINGS, Press
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Minster Mch. Co., Minster, Ohio
Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y. (die-pressed)
Vanadium-Alloys Steel Co., Latrobe, Penna.
Wyman-Gordon Co., Worcester, Mass.

FORGINGS, Upset
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Vanadium-Alloys Steel Co., Latrobe, Penna.

FORMING MACHINES, Cold-Rolling
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Michigan Tool Co., Mount Gilead, Ohio Detroit 12, Mich.
Niagara Mch. & Tool Works, 637 Northland Ave., Buffalo, N. Y.
Yoder Co., 5500 Walworth, Cleveland, Ohio

EDLUND

The Greatest Advance in Drilling and Tapping Machine in the Past 25 Years

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QUALITY IMPROVED
COSTS REDUCED

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Production line of EDLUND Model 2F Infinitely Variable Speed Drilling and Tapping machines turns out drilled and tapped parts faster, with better quality and at lower cost.

These powerful EDLUND machines give constant service with minimum downtime and feature flexibility to handle a wide variety of drilling, reaming, chamfering, counterboring, and tapping operations.

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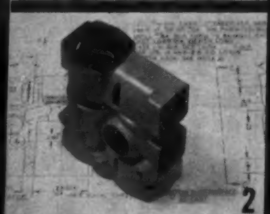
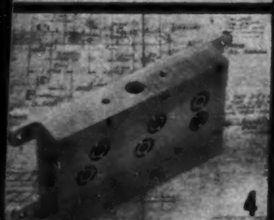
Model 2G Gun Drilling — 5/8" Capacity — Spindle speeds to 8000 rpm. — Bulletin 2G





Some of the many precision parts drilled and tapped with EDLUND Model 2F machines at Aro Equipment Corporation:

1. AIR TOOL HOUSING—8 drilling operations, 2 tapped holes #32 7/16".
2. AUTO VALVE BODY—15 holes, 10-32, Class 3 threads.
3. BRASS PUMP BLOCK—30 drilling, reaming and tapping operations.
4. VALVE BODY—16 spindle operation, 1/8"-3/8" holes, and 12 counterbores.

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Cortland, New York
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FORMING MACHINES, Multiple-slide

Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Brown & Sharpe Mfg. Co., Providence, R. I.
Chambersburg Engrg. Co., Chambersburg, Pa.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
J. S. Tool Co., Inc., 255 North Main St., Ampere, E. Orange, N. J.

FORMING TOOLS or Tool Blanks

Brown & Sharpe Mfg. Co., Providence, R. I.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

GAGE BLOCKS

Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., Des Plaines, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GAGES, Air Comparator

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Automatic Sorting

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, DIAL, Bore, Height, Depth, Thread, Groove, etc.

Ames, B. C., Co., Waltham 54, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cadillac Gage Co., P. O. Box 3806, Detroit, Mich.
Comtor Co., 47 Farwell St., Waltham 54, Mass.
DoALL Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GAGES Electric Comparator

Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Grinding

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 893, Dayton 1, Ohio

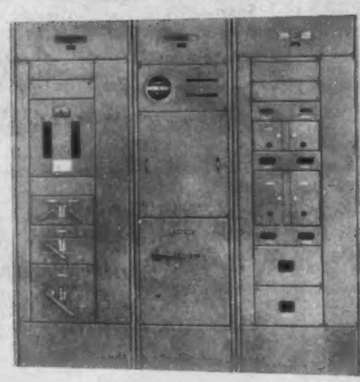
GAGES, Machinists' Hand, including Center, Cutter Clearance, Drill Point, Drill Size, Planer, Radius, Screw Pitch, Taper Telescoping Thickness

Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

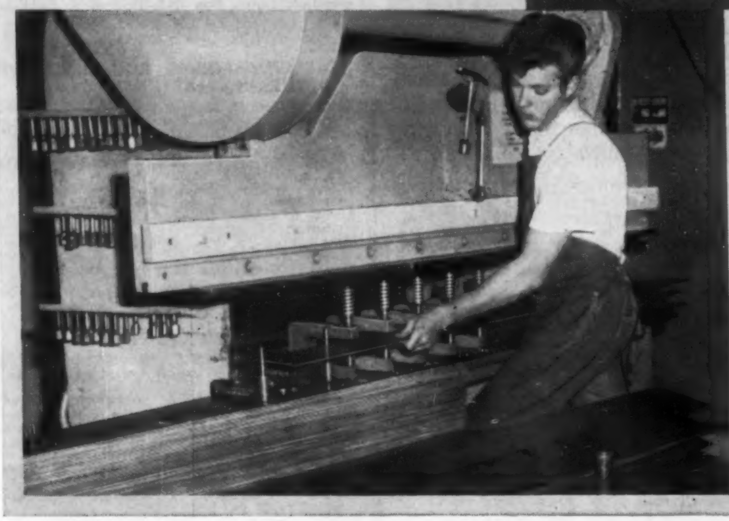
GAGES, Multiple Inspection

Federal Products Corp., 1144 Eddy St., Providence 1, N. Y.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio

Built better by "BULLDOG"... using THE COST-CUTTING STRIPPIT SYSTEM



Power switchboard by BULLDOG ELECTRIC. Fully interchangeable parts.



PRESS SETUPS OFF THE SHELF!
BULLDOG ELECTRIC stores Strippit drilled templates on conveniently located shelves, Strippit Hole Punching Units and Tooling on this mobile rack. Pilot pins on units slip-fit into template pilot holes for exact positioning, quick mounting outside press by bench man. All units reusable over and over in unlimited patterns.

NO LOSS OF PRESS TIME!
Strippit setups cut between-run time to a minimum—just remove last setup from press bed, insert new one and start run. Both short and long runs are profitable with Strippit setups. Here, parts for BULLDOG switchboards are being perforated accurately and rapidly. In other operations, Strippit Notching Units provide equal flexibility.

H. J. LOCKWOOD, Plant Superintendent, **BULLDOG ELECTRIC PRODUCTS** of Los Angeles writes:

"In building BULLDOG Switchboards to perfect uniformity for full interchangeability of parts, I have centered our production methods around Strippit tooling. All the perforating and notching operations are performed without fixed dies. Work flows smoothly through the machines without tieups. In no other way could we produce this quality product so efficiently."

A UNIT OF HOUDAILLE INDUSTRIES, INC.

WALES STRIPPIT INC.

203 Buell Road, Akron, New York

Manufactured in Canada by: Strippit Tool & Machine Company, Brampton, Ont.

WRITE TODAY for details on the savings you could be enjoying with Strippit setups on your presses!

GAGES, Plug and Ring

Brown & Sharpe Mfg. Co., Providence, R. I.
Deltronic, Costa Mesa, Calif.
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.
Winter Bros. Co., Rochester, Mich.

GAGES, Roll Thread Snap, Adjustable Snap

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

GAGES, Surface Roughness

DoAll Co., Des Plaines, Ill.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, VERNIER, Height, Depth, Gear Tooth

Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.

GEAR BURNISHERS

Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GEAR CHAMFERING, ROUNDING AND DEBURRING MACHINES

Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GEAR CHECKING EQUIPMENT

Brown & Sharpe Mfg. Co., Providence, R. I.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR CUTTING MACHINES, Bevel and Spiral

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR CUTTING MACHINES, Worm and Worm Wheels

Barber-Colman Co., 1300 Rock St., Rockford, Ill.

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
New Jersey Gear & Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR GRINDERS—See Grinding Machines, Gear

GEAR HOBBERS

American Schiess Corp., 1232 Penn. Ave., Pittsburgh 22, Pa.
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

GEAR HONERS

National Broach & Mch. Co., 5600 St. Jean, Detroit 13, Mich.

GEAR LAPPERS

Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean, Detroit 12, Mich.

GEAR MOTORS—See Speed Reducers

GEAR RACKS

Illinois Gear & Mch. Co., 2108 N. Natchez Ave., Chicago 5, Ill.
Stahl Gear & Mch. Co., The, 3901 Hamilton Ave., Cleveland 4, Ohio.

GEAR SHAPERS

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

GEAR SHAVERS

Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.

GEARS, AND GEAR BLANKS, Non-metallic

Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Cincinnati Gear Co., Wooster Pike and Mariemont Ave., Cincinnati, Ohio.
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio
Illinois Gear & Mch. Co., 2108 N. Natchez Ave., Chicago 5, Ill.
New Jersey Gear & Mfg. Co., Hillside, N. J.
Ryerson, Jos. T. & Son, Inc., 16th and Rockwell St., Chicago 8, Ill.
Stahl Gear & Mch. Co., 3901 Hamilton Ave., Cleveland 14, Ohio

GEARS, Cut

Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Cincinnati Gear Co., Wooster Pike and Mariemont Ave., Cincinnati, Ohio
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio.

(Continued on page 278)

Horsburgh & Scott Co., 5114 Hamilton Ave., Cleveland 14, Ohio
Illinois Gear & Mch. Co., 2108 N. Natchez Ave., Chicago 5, Ill.
James D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
New Jersey Gear Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Stahl Gear & Mch. Co., 3901 Hamilton Ave., Cleveland 14, Ohio
Verson Allsteel Press Co., 93rd St., & S. Kenwood Ave., Chicago, Ill.

GRADUATING MACHINES

Gorton Geo., Mch. Co., 1321 Racine St., Racine, Wis.

GREASES—See Lubricating Oils and Greases

GRINDERS, Bench, Floor and Snag

Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Carbide Tool

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DoAll Co., Des Plaines, Ill.
Elox Corp. of Michigan, Troy, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

GRINDERS, Die and Mold

DoAll Co., Des Plaines, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Drill Point

Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Oliver Instrument Co., 1410 E. Maumee, Adrian, Mich. (also drill point thinner)
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio.

GRINDERS, Face Mill

Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Mattison Machine Works, 545 Blackhawk Park Ave., Rockford, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

GRINDERS, Knife and Shear

Hill Acme Co., 1201 W. 65th St. Cleveland 2, Ohio
Mattison Machine Works, Rockford, Ill.
Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Portable Electric

Chicago Pneumatic Tool Co., New York 17, N. Y.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati 4, Ohio

GRINDERS, Portable Pneumatic

Chicago Pneumatic Tool Co., New York 17, N. Y.
Madison-Kipp Corp., Madison, Wis.

GRINDERS, Tap

Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.

GRINDERS, Tool and Cutter

Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Elox Corp. of Michigan, Troy, Mich.
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Gallmeyer & Livingston Co., 336 Straight Ave., S. W., Grand Rapids 4, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Gorton, Geo., Mch. Co., 1321 Racine St., Racine, Wis.
Landis Tool Co., Waynesboro, Pa.
LeBlond, R. K., Mch. Tool Co. Madison and Edwards Rds., Cincinnati 18, Ohio
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio

GRINDERS, Toolpost

Cosa Corp., 305 Lexington Ave., New York 17, N. Y.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING GAGES—See Gages, Grinding

GRINDING MACHINES, Abrasive Belt

Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Mch. Works, Rockford, Ill.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Broach

Gallmeyer & Livingston Co., 336 Straight, S. W. Grand Rapids 2, Mich.
National Broach & Mch. Co., 5600 St. Jean, Detroit 13, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder, 1534 W. Main, Springfield, Ohio

GRINDING MACHINES, Cam

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Landis Tool Co., Waynesboro, Pa
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Centerless

Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Landis Tool Co., Waynesboro, Pa.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Crankshaft

Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Cylindrical

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Landis Tool Co., Inc., Waynesboro, Pa.
Micromatic Home Corp., 81100 Schoolcraft Ave., Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Disc

Brown & Sharpe Mfg., Co., Providence, R. I.
Gardner Machine Co., Beloit, Wis.
Mattison Machine Co., Beloit, Wis.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Gear

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Gear Grinding Machine Co., 3901 Christopher St., Detroit 11, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Internal

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S. W. Grand Rapids 2, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co. 2488-90 River Rd., Cincinnati, Ohio
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

GRINDING MACHINES, Jig

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio
Gallmeyer & Livingston Co., 336 Straight S. W., Grand Rapids 2, Mich.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.

GRINDING MACHINES, Profile

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Roll

Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.

GRINDING MACHINES, Surface Reciprocating

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc. Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DoAll Co., Des Plaines, Ill.
Elox Corp. of Michigan, Troy, Mich.
Gallmeyer & Livingston Co., 336 Straight, S.W. Grand Rapids 4, Wis.
Gardner Machine Co., Beloit, Wis.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Homestrand, Inc., Larchmont, N. Y.
Mattison Machine Works, Rockford, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Surface Rotary
Berthiez, Charles 5 Rue Montalivet, Paris, France
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Mattison Machine Works, Rockford, Ill.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
Walker, O. S. Co., Inc., Worcester, Mass.

GRINDING MACHINES, Thread
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Machine Co. (Centerless), Waynesboro, Pa.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Universal
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch Co., Springfield, Vt.
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

GRINDING WHEEL DRESSING AND FORMING DEVICES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Metal Carbides Corp., Youngstown, Ohio
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport 7, Conn.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio

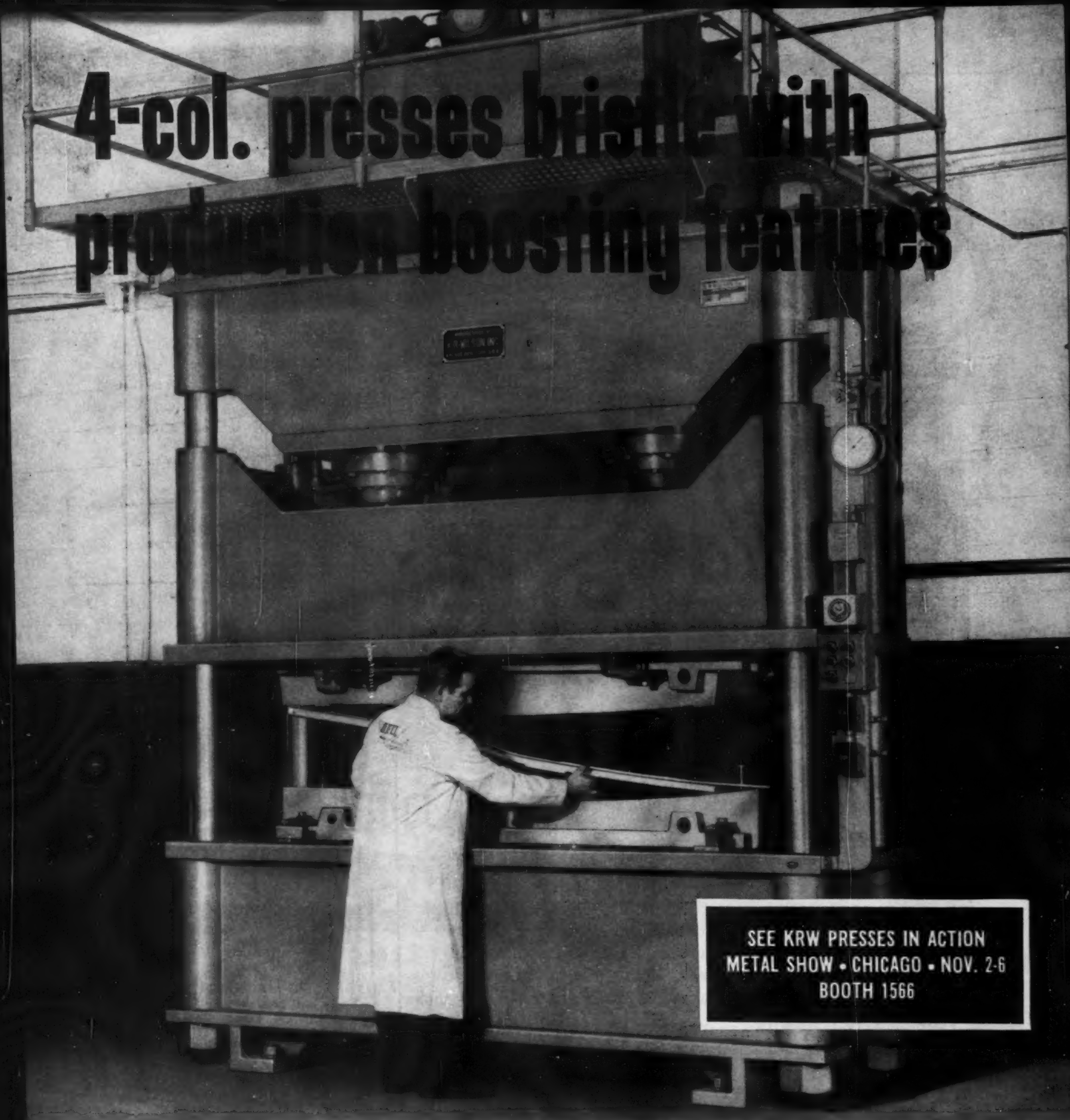
GRINDING WHEELS
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cratex Mfg. Co., 81 Natoma St., San Francisco 5, Cal.
Gardner Machine Co., Beloit, Wis.
Macklin Co., Jackson, Mich.
Metal Carbides Corp., Youngstown, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.

GROOVING TOOLS, Internal
Kennametal, Inc., Latrobe, Penna.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 35, Penna.
Waldes Kohinoor, Inc., 47-16 Austel Pl., Long Island City 1, N. Y.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

HAMMERS, Drop—See Forging Hammers

HAMMERS, Portable Pneumatic
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

HAMMERS, Power
Chambersburg Engrg. Co., Chambersburg, Pa.
Edlund Mchry. Co. Div., Cortland, N. Y.



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Erie Foundry Co, 1253 W. 12th St., Erie Penna.
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

HARDNESS TESTERS

Shore Instrument & Mfg. Co., 90-35C Van Wyck Exp., Jamaica 35, N. Y.

HEAT-TREATING EQUIPMENT — See Annealing Furnaces, Flame Hardening Machines, Induction-Heating Equipment

HOBS

Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Twist Drill & Tool Co., Rochester, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

HOISTS, Air

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

HOISTS, Electric

Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

HONING MACHINES

Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Moline Tool Co., 102-120th St., Moline, Ill.
Superior Hone Corp., 1623 Elreno St., Elkhart, Ind.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

HONING STONES

Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.

HOSE

American Metal Hose Br. American Brass Co., 25 Broadway, New York, N. Y.
Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

HYDRAULIC MACHINERY
Tools and equipment

Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Bethlehem Steel Corp., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.
Bliss, E. W., Co., 1375 Raff Rd., E. W. Canton, Ohio
Burg Tool and Mfg. Co., Inc., 15001 S. Figueora, Gardena, Calif.
Chambersburg Engrg. Co., Chambersburg, Pa.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co.. Erie, Pa.
Hannifin Co.,., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead Ohio
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Michigan Drill Head Co., Detroit 34, Mich.
Modern Ind. Engrg. Co., 14230 Birwood Ave., Detroit 4, Mich.
Northern Hydraulics & Mch. Corp., Melrose Park, Ill.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Vickers Incorporated, Div. of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

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Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Michigan Drill Head Co., Detroit 34, Mich.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers Incorporated, Div. of Sperry Rand Corporation, 1402 Oakman Blvd., Detroit, Mich.

INDEXING and SPACING EQUIPMENT

Brown & Sharpe Mfg. Co., Providence, R. I.
Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
L-W Chuck Co., Toledo 4, Ohio
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

INDICATOR BASES, Magnetic

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
du Mont Corp., Greenfield, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

INDICATORS, Dial

Ames, B. C., Waltham 54, Mass.
Brown & Sharpe Co., Providence, R. I.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
National Automatic Tool Co., S. 7th - N. Sts., Richmond, Ind.

INDICATORS, Speed

Brown & Sharpe Mfg Co., Providence, R. I.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.

INDICATORS, Test

Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
National Automatic Tool Co., S. 7th & N. Sts., Richmond, Ind.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

INDUCTION HEATING EQUIPMENT

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Lepel High Frequency Laboratories, Inc., Woodside 77, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

INTENSIFIERS, Hydraulic

Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Logansport Mch. Co., Inc., Logansport, Ind.

JACKS, Planer—See Set-up Equipment

JIG BORERS

American Sip Corp., 100 E. 42nd St., New York 17, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., Fair St., Royal Oak, Mich.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Homestrand, Inc., Larchmont, N. Y.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.
Orban, Kurt., Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

JIGS AND FIXTURES

Bath, Cyril Co., Aurora & Solon Road, Solon, Ohio
Columbus Die Tool & Mch. Co., 955 Cleveland Ave., Columbus, Ohio
Hartford Special Mchry. Co., 287 Homestead Ave., Hartford, Conn.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Metal Carbides Corp., Youngstown 12, Ohio
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio

KEYSEATERS

Baker Bros., Inc., Station F, P. O. Box 101, Toledo 10, Ohio
Bliss, E. W. Co., Canton, Ohio
Mitts & Merrill, 1809 S. Water St., Saginaw, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

KNURLING TOOLS

Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Williams J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

LAPPING MACHINES

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gleason Works, 1000 Univedsity Ave., Rochester, N. Y.
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.

LATHE ATTACHMENTS

Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio.
Sheldon Mch. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
Sidney Mch. Tool Co., Sidney, Ohio
Williams, J. H. & Co, 400 Vulcan St., Buffalo 7, N. Y.

LATHES, AUTOMATIC—See Chucking Machines

LATHES, Axle

Consolidated Mch. Tool Div., Farrel-Birmingham Co., Inc., Rochester 10, N. Y.
Hamilton Div., Baldwin-Lima-Hamilton Corp. Hamilton, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Bench

Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

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Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio

LATHES, Copying, Duplicating — See Lathes, Duplicating

LATHES, Crankshaft
Consolidated Mch Tool Corp., Rochester, N. Y
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds, Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Double-End
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co, Madison and Edwards Rds., Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2351 11th St., Rockford, Ill.

LATHES, Duplicating
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Monarch Machine Tool Co., 27 Oak St., Sidney Ohio
Sidney Machine Tool Co., Highland Ave. Sidney, Ohio

LATHES, Engine, Manufacturing
American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Consolidated Mch. Tool Div, Blossom Road. Rochester 10 N. Y.
Hendey Mch. Div., Barber Colman Co., Rockford, Ill.
Homestrand, Inc., Larchmont, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio.
Orban, Kurt Co., Inc., 42 Exchange Place. Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.
Sidney Mch. Tool Co., Sidney, Ohio

LATHES, Engine, Toolroom
American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Hardinge Bros. Inc., 1420 College Ave., Elmira, N. Y.
Hendey Mch. Div., Barber Colman Co., Rockford, Ill.
Homestrand, Inc., Larchmont, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Logan Engineering Co., 4901 Lawrence Ave., Chicago 30, Ill.
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio.
Orban, Kurt Co., Inc., 42 Exchange Place Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.
Sidney Mch. Tool Co., Sidney, Ohio

LATHES, Gap
Cincinnati Lathe & Tool Co., 3207 Disney St. Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Clearing Div., of U. S. Industries, Inc., 649. W. 65th St., Chicago 38, Ill.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio.
Sidney Machine Tool Co., Highland Ave. Sidney, Ohio

LATHES, Hollow Spindle
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
South Bend Lathe Works Inc., 425 E. Madison St., South Bend. Ind.

LATHES, Roll
American Tool Works Co., Pearl and Eggleston Aves., Cincinnati 2, Ohio
Bliss, E. W., Co., Canton, Ohio
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

LATHES, Speed. Second-operation
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Gisholt Machine Co, 1245 E Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheldon Mch. Co., 4258 N. Knox Ave., Chicago 41, Ill.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

LATHES, Spinning
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Casa Corp., 405 Lexington Ave., New York 17, N. Y.
Lodge & Shipley Co., The, Cincinnati 25, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place. Jersey City 2, N. J.

LATHES, Toolroom—See Lathes, Engine, Toolroom

LATHES, Turret, Automatic
Bullard Co., Bridgeport 2, Conn.
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
New Britain Mch. Co., New Britain-Gridley Divn., New Britain, Conn.

LATHES, Turret, Ram Type Saddle Type
Bardons & Oliver, Inc., 1133 W. Ninth St., Cleveland 13, Ohio
Bullard Co., Bridgeport 2, Conn.
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Brothers, Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.
Sheldon Mach. Co., Inc., 4258 N Knox Ave., Chicago 41, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio

LATHES, Turret, Vertical—See Boring Mills, Vertical

LAYOUT and DRAFTING TOOLS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.

LEAD SCREWS & SPLINES, Ball Bearing
Saginaw Steering Gear Div., General Motors Corp., Saginaw, Mich.

LIMIT SWITCHES—See Switches, Limit

LUBRICATING OILS and GREASES
Cities Service Oil Co., 70 Pine St., New York, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Standard Oil Co. (Indiana), 910 S Michigan, Chicago, Ill
Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St., Chicago 23, Ill.
Texaco, Inc., 135 E. 42nd St. New York 17, N. Y.

LUBRICATING SYSTEMS
Gits Bros. Mfg. Co., 1846 S. Kilbourn Ave., Chicago 23, Ill.
Madison-Kipp Corp., Madison, Wis.
Trabon Engineering Corp., Solon, Ohio

MACHINERY, Used and Rebuilt
Eastern Mchry. Co., 1000 Tennessee Ave., Cincinnati, Ohio
Miles Mchry. Co., 2025 E. Genessee Ave., Saginaw, Mich.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio
Van Keuren Co., Watertown 72, Mass.

MACHINISTS' SMALL TOOLS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoALL Co., Des Plaines, Ill.
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

MANDRELS—See Arbors and Mandrels

MARKING MACHINES and DEVICES
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Pannier Corp., 319 Pannier Bldg., Pittsburgh 12, Pa.

MATERIAL-HANDLING TRUCKS—See Trucks, Material Handling

MEASURING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., 721 Springfield St., Dayton, 1, Ohio
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.

MEASURING WIRES—Thread, Spline, Gear
Sheffield Corp., Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.

MICROMETER HEADS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoALL Co., Des Plaines, Ill.

MICROMETERS, Outside, Inside, Depth
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoALL Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.

MICROSCOPES, Toolmakers'
DoALL Co., Des Plaines, Ill.
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

MILLING MACHINE ATTACHMENTS
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches, Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gorton, George Mch. Co., 1110 W. 13th St., Racine, Wis.
Greaves Mch. Tool Div., 2011 Eastern Ave., Cincinnati 2, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.

Sheldon Mch. Co., Inc., 4258 N Knox Ave., Chicago 41, Ill.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Automatic

Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Cincinnati Milling Machine Co., Cincinnati, Ohio
Consolidated Machine Tool Corp., Rochester, N. Y.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Nichols, W. H. Co., Waltham 54, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

MILLING MACHINES, Bed Type, Simplex, Duplex

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Cincinnati Milling & Grinding Mches., Inc., 470 Marburg Ave., Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Espen-Lucas Mch. Wrks., Front St., and Girard Ave., Philadelphia, Pa.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio
Nichols, W. H. Co., Waltham 54, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island 1, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Bench, Hand

Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Hardinge Bros. Inc., 1420 College Ave., Elmira, N. Y.

MILLING MACHINES, Circular, Continuous

Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 6411 W. Burnham St., Milwaukee 14, Wis.
Espen Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Nichols, W. H. Co., Waltham 54, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Snyder Tool & Engrg. Co., 3400 E. Layfayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2351 11th St., Rockford, Ill.

MILLING MACHINES, Die Sinking, Duplicating, Profiling

Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Elox Corp. of Michigan, Troy, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gorton, George, Machine Co., 1110 W. 13th St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Knee Type, Horizontal, Plain, Universal

Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Clearing Div., of U.S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton Geo., Mch., Co., 1110 W. 13th St., Racine, Wis.
Greaves Machine Tool Div., 2009 Eastern Ave., Cincinnati, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Homestrand, Inc., Larchmont, N. Y.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Sheldon Machine Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

MILLING MACHINES, Knee Type Ram

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Knee Type Rise and Fall

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., 42 Exchange Place, Jersey City, N. J.

MILLING MACHINES, Knee Type Turret

Gorton Mch. Co., 1321 Racine St., Racine, Wis.

MILLING MACHINES, Knee Type, Vertical

Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches., Inc. 4701 Marburg Ave., Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cosa Corp., 450 Lexington Ave., New York 17, N. Y.
Gorton, George, Mch. Co., 11110 W. 13th St., Racine, Wis.
Homestrand, Inc., Larchmont, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

MILLING MACHINES, Planer Type

Berthiez, Charles, 5 Rue Montalivet, Paris, France
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., Woodburn Ave. and Penn R.R., Evanston, Cincinnati, Ohio
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker, Corp., 6784 W. National, Milwaukee 14, Wis.
Orban, Kurt Co., Inc., 42 Exrhange Place, Jersey City, N. J.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Spar

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MOLDING MACHINES, Plastic

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinati 29, Ohio
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

MOTORS, Electric

Brook Motor Corp., 3302 W. Peterson Ave., Chicago 45, Ill.
Lincoln Electric Co., Cleveland 17, Ohio

MOTORS, Hydraulic

Barnes, John S. Corp., Rockford, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hydraulic Press Mfg. Div., Mt. Gilead, Ohio
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

MULTIPLE INSPECTION GAGES—See Gages, Multiple Inspection

MULTIPLE-STATION MACHINES, Dial Type

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Baush Mch. Tool Co., 15 Wason Ave., Springfield, Mass.
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Greenlee Bros. & Co., 2136 12th St., Rockford, Ill.
Kingsbury Mch. Tool Corp., Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
National Automatic Tool Co., S. 7th N. St., Richmond, Ind.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, Ill.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

MULTIPLE-STATION MACHINES, Transfer Type

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Baush Mch. Tool Co., 15 Wason Ave., Springfield, Mass.
Buhr Mch. Tool Co., 839 Green St., Ann Arbor, Mich.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling Mch. Co., Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Davis & Thompson Co., 4460 N. 124th St., Milwaukee 10, Wis.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Greenlee Bros. & Co., 2136 - 12th St., Rockford, Ill.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
La Maire Machine Tool Co., 2657 S. Telegraph Road, Dearborn, Mich.
Moline Tool Co., 102-20th St., Moline, Ill.
National Automatic Tool Co., S. 7th N. Sts., Richmond, Ind.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Sundstrand Mch., Tool Co., 2531 11th St., Rockford, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

NIBBLERS, Portable Pneumatic

Buckeye Tools Corp., Dayton, Ohio

NIBBLING MACHINES

Wales-Strippit, Inc., Akron, N. Y.

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NUTS—See Bolts, Nuts and Screws

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Gits Bros. Mfg. Co., 1858 S. Kilburn Ave., Chicago, Ill.
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PAINTING EQUIPMENT, Spray—See Spraying Equipment, Metal

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S K F Industries, Inc., Philadelphia, Penna.

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Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
United States Steel Corp., National Tube Co., Div., 436 7th Ave., Pittsburgh, Pa.

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Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

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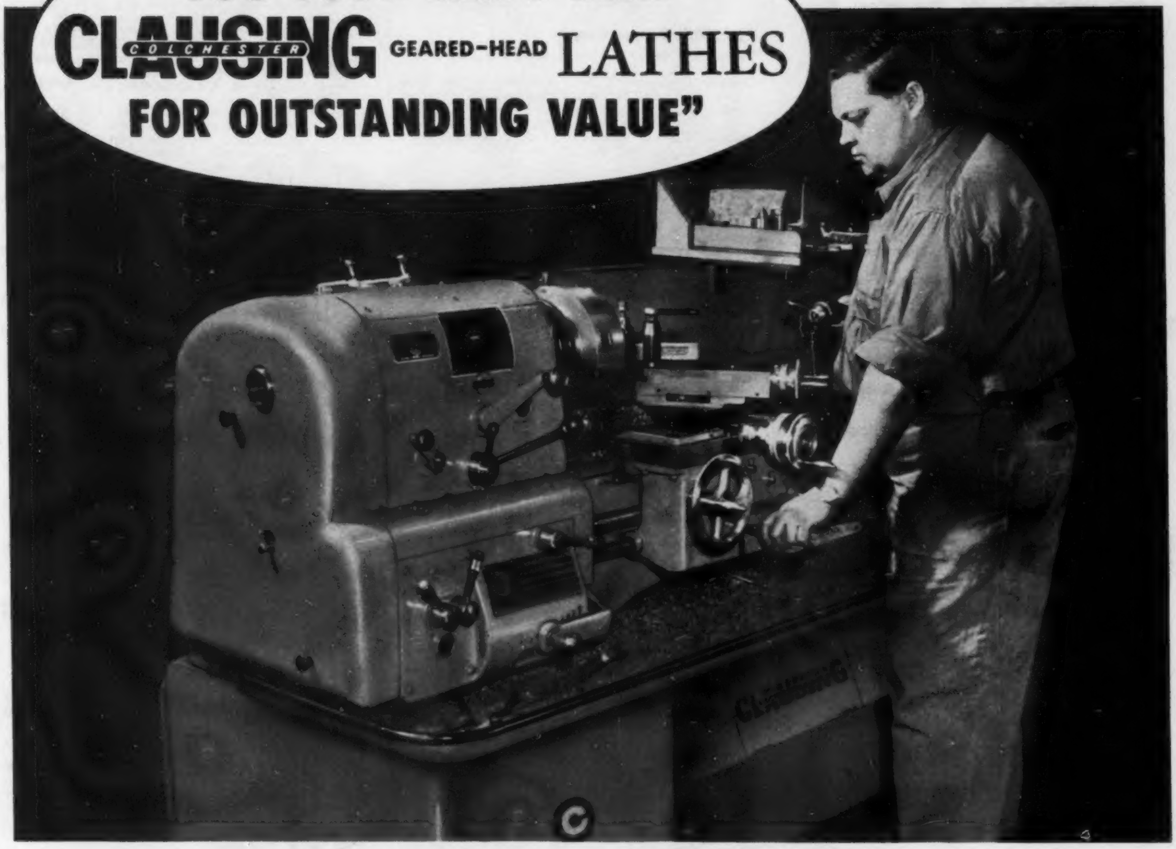

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PLANERS, Double Housing and Openside

Berthiez, Charles, 5 Rue Montalivet, Paris, France
Consolidated Mch. Tool Div., Rochester, N. Y.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A. Co., 3611 Woodburn Ave., Cincinnati, Ohio
Hamilton Div., Balwin-Lima-Hamilton Corp., Hamilton, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.

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Gisholt Mch. Co., Madison, Wis.
U. S. Steel Corp., Nat'l Tube Div., Pittsburgh, Pa.

PRESS BRAKES—See Brakes, Press and Bending

PRESS FEEDERS, Automatic

Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
U. S. Tool Co., 255 N. 18th St., Ampere, East Orange, N. J.

PRESSES, Arbor

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
du Mont Corp., Greenfield, Mass.
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Logansport Machine Co., Inc. Lo[illegible]ort, Ind.
Threadwell Tap & Die Corp., [illegible] Arch St., Greenfield, Mass.
Wilson, K. R., Inc., Arcade, N. Y.

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Allen, Alva Industries, Clinton, Mo.
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Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Federal Press Co., 511 Division St., Elkhart, Ind.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Northern Hydraulics & Mach. Corp., Melrose Park, Ill.

PRESSES, Blanking, Stamping

Allen, Alva Industries, Clinton, Mo.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
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Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Denison Engineering, Div. American Brake Shoe Co., 152 Dublin Rd., Columbus 16, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
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L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
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Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
U. S. Tool Co., Inc., 255 N. 8th St., Ampere, East Orange, N. J.
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Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Briquetting

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
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Hydraulic Press Mfg. Co., Mount Gilead, Ohio
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PRESSES, Closed-Die Forging

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Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
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Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
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Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Coining, Embossing

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
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Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave. Chicago 19, Ill.
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PRESSES, Die Sinking (Hobbing)

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
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PRESSES, Die Tryout

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Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
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Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Federal Press Co., 511 Division St., Elkhart, Ind.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Drawing

Allen, Alva Industries, Clinton, Mo.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Cincinnati Milling & Grinding Machines, Inc., 4710 Marburg Ave., Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
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Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
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Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
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PRESSES, Extrusion

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
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Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
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Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Foot

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Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Horning

Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Notching

Allen, Alva Industries, Clinton, Mo.
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Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wales-Strippit, Inc., Akron, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Punching, Piercing

Allen, Alva Industries, Clinton, Mo.
Beatty Machine & Mfg. Co., Hammond, Ind.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
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Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Quenching
Gleason Wks., 1000 University Ave., Rochester 3, N. Y.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio

PRESSES, Rubber-Forming
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Cincinnati Milling & Grinding Machines, Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9303 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Trimming
Allen, Alva Industries, Clinton, Mo.
Beatty Machine & Mfg. Co., Hammond, Ind.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
B-T Machinery Co., Holland, Mich.
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks., Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St, Erie, Penna.
Federal Press Co., 511 Division St., Elkhart, Ind.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart Ind.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PROFILING MACHINES—See Milling Machines, Die Sinking, etc.

PULLEYS
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., Des Plaines, Ill.

PUMPS, Coolant and Lubricant
Barnes, John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., Des Plaines, Ill.
Ingersoll-Rand Co., Phillipsburg, N. J.
Little Giant Pump Co., 5101 Classen Blvd., Oklahoma City 18, Okla.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Ruthman Machinery Co., 1809 Reading Rd., Cincinnati, 2, Ohio

PUMPS, Hydraulic
Barnes, John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Div., Mount Gilead, Ohio
Sundstrand Machine Tool Co., 2531 11th St., Rockford, Ill.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.
Wilson, K. R., Inc., Arcade, N. Y.

PUNCHES AND DIES—See Dies, Blanking, etc.

REAMERS, Rose, Chucking, Jobbers Taper, Shell, Adjustable, etc.
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 49th St., Cleveland, Ohio
Cogsdill Twist Drill Co., Greenfield, Mass.
DoALL Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jarvis Corp., Stack Ave., Middletown, Conn.
Tomkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich.

REELS, Stock
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

REFRACTORS Heat-Treating Furnaces
Norton Co., 1 New Bond St., Worcester 6, Mass.

RETAINING RINGS
Waldes Kohinoor, Inc., 47-16 Austel Pl., Long Island City 1, N. Y.

RIVETERS, Portable
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.

RIVETERS, Stationary
Brown & Sharpe Mfg. Co., 35 Promenade St., Providence 1, R. I.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Tompkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich.

ROTARY TABLES, Optical
Machine Products Corp., 6771 E. McNichols Rd., Detroit 12, Michigan

RULES, SCALES AND STRAIGHTEDGES
See Machinists' Small Tools

RUST INHIBITORS
Oakite Products, Inc., 26 Rector St., New York, N. Y.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St., Chicago 23, Ill.

SAND BLAST EQUIPMENT—See Blast Cleaning Equipment

SAW BLADES, Hack, Band, Circular Friction
Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
Capewell Mfg. Co., 60 Governor St., Hartford, Conn.
Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
DoALL Co., Des Paines, Ill.
Espen-Lucas Mach Works, Philadelphia, Pa.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio

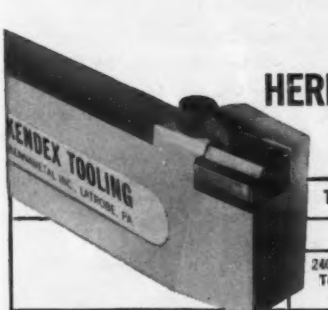
(Continued on page 296)

DON'T WASTE DOLLARS

IN MACHINE OUTPUT

TO SAVE PENNIES

IN TOOL LIFE



HERE'S HOW SOME SHOPS HAVE DOUBLED AND TRIPLED THE OUTPUT OF EXPENSIVE MACHINES

Typical Examples—Same Machines ... Same Tools ... Same Workpieces								
	Job No. 1		Job No. 2		Job No. 3		Job No. 4	
	240-Minute Tool Life Setup	25-Minute Tool Life Setup	75-Minute Tool Life Setup	25-Minute Tool Life Setup	120-Minute Tool Life Setup	80-Minute Tool Life Setup	120-Minute Tool Life Setup	22-Minute Tool Life Setup
Machine Cost per Hour	$ 8.00	$ 8.00	$10.00	$10.00	$ 9.00	$ 9.00	$ 9.00	$ 9.00
Tool Cost per Hour	$ .04	$ .40	$ .36	$ .76	$ .14	$ .215	$ .14	$ .77
Cost per 8-Hour Shift	$64.32	$67.20	$82.88	$86.08	$73.12	$73.72	$73.12	$78.16
Pieces per Shift	51	181	8	17	94 hrs./pc.	41 hrs./pc.	8	16
Cost per Piece	**$ 1.26**	**$ .37**	**$10.36**	**$ 5.06**	**$859.16**	**$377.81**	**$ 9.14**	**$ 4.88**
Cost Reduction	70%		51%		56%		47%	

Get the complete story ... send for the booklet "There's Profit in Retiring a Tradition."

From many machine shops the story is the same—*they are sacrificing low-cost carbide inserts through increased feeds and speeds . . . to achieve startling savings in total-cost-per-piece.* Production increases even greater than 100% have been recorded. The increased tool costs were insignificant by comparison.

Where machines have been operating at less than maximum efficiency, *unit cost can be reduced on many jobs overnight* . . . merely by using modern cutting tools to get full potential machine output . . . instead of operating at fractional machine capacity to gain long tool life.

This idea has been *PROVEN-IN-USE* by many progressive plants. We will gladly send you records of such operations. These results can be duplicated in plants where machines and talented operators have been held back by old ideas about tooling and tooling costs. Ask your Kennametal Carbide Engineer how Kendex* (patented) tooling can help you get more efficient output from your machines . . . or write KENNAMETAL INC., Latrobe, Pennsylvania, for the booklet "There's Profit in Retiring a Tradition."

*Trademark

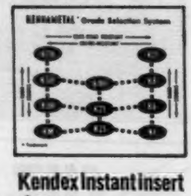
9-7229

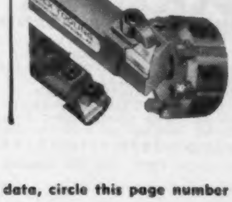
INDUSTRY AND
KENNAMETAL
...Partners in Progress

TO MULTIPLY YOUR MACHINE OUTPUT ...YOU NEED 3 THINGS:

The 'Three-Man Tooling Team' that utilizes the specialized knowledge of your Tool Engineer, your Machine Operator, and the Kennametal Carbide Engineer . . . *to get the right tooling on every job.*

The Kennametal complete range of grades that provides the precise properties and uniformity that permits *accurate prediction of tool life.*





Kendex Instant insert change without need to reposition the tool. This is the key to this new practice . . . *frequent tool change without excessive down-time.*

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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio

SAWING MACHINES, Abrasive Machines—See Cutting-off Saws, Abrasive Wheel

SAWING MACHINES, Band
Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
DoALL Co., Des Plaines, Ill.

SAWING MACHINES, Circular Blade
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio
Ty-Sa-Man Machine Co., Inc., 1093 White Ave., Knoxville, Tenn.

SAWING MACHINES, Power Hack
Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.

SAWS, Screw-slotting—See Cutters, Milling

SCREW DRIVERS, STUD AND NUT SETTERS, Power
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10. N. Y.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Scully-Jones & Co., 1906 Rockwell St., Chicago 8, Ill.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

SCREW MACHINES, Hand—See Lathes, Turret, Ram-type, Saddle-type

SCREW MACHINES, Multiple-Spindle Automatic
Greenlee Bros. & Co., 2136 12th St., Rockford, Ill.
National Acme Co., 170 E. 31st St., Cleveland, Ohio
New Britain Mch. Co., New Britain-Gridley Mch Div., New Britain, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Warner & Swasey Co., 6701 Carnegie Ave., Cleveland 3, Ohio

SCREW MACHINES, Single-Spindle Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gear Grinding Machine Co., 3901 Christopher St., Detroit 11, Mich.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton, George Mch. Co., 1110 W. 13th St., Racine, Wis.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.

SCREW PLATES
Greenfield Tap & Die Corp., Greenfield, Mass.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

SCREWS, Cap, Set, Self-tapping, etc.—See Bolts, Nuts and Screws

SEALS AND RETAINERS—Oil or Grease
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago, Illinois

SEPARATORS, Magnetic
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

SET-UP EQUIPMENT
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Lufkin Rule Co., Saginaw, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

SHAPERS, Crank and Hydraulic
Cincinnati Shaper Co., P. O. Box 111, Cincinnati 11, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Nebel Machine Tool Corp., 3401 Central Pkwy, Cincinnati 25, Ohio
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

SHAPERS, Vertical and Slotters
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Orban, Kurt Co., 42 Exchange Place, Jersey City 2, N. J.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.

SHEARS, Alligator
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio

SHEARS, Guillotine Bar
Beatty Machine & Mfg. Co., Hammond, Ind.

SHEARS, Rotary
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.

SHEARS, Squaring
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Cincinnati Shaper Co., P. O. Box 111, Cincinnati 11, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.

SHEET METALS—See Strip and Sheet, Ferrous, Non-ferrous

SHIM STOCK
Laminated Shim Co., Inc., Glenbrook, Conn.

SLITTING MACHINES, Rotary
Bliss Co., E. W., Canton, Ohio
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

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SLOTTERS—See Shapers, Vertical and Slotters

SOCKETS—See Drill Sleeves and Extension Holders

SOLENOIDS
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Barnes, John S. Corp., Rockford, Ill.
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

SPECIAL MACHINERY AND TOOLS
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Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., 201 S. Water St., Rockford, Ill.
Baush Machine Tool Co., 156 Wason Ave., Springfield 7, Mass.
Bethlehem Steel Co., Bethlehem, Pa.
Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Blanchard Mch. Co., 64 State St., Cambridge, Mass.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Buhr Mch. Tool Co., 839 Green St., Ann Arbor, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Chambersburg Engrg. Co., Chambersburg, Pa.
Cincinnati Milling Mch. Co., Oakley, Cincinnati 9, Ohio.
Columbus Die-Tool & Mch. Co., 955 Cleveland Ave., Columbus, Ohio.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Erie Foundry Co., Erie, Pa.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Federal Machine & Welder Co., Overland Ave., Warren, Ohio.
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton, Geo., Mch. Co., 1110 W. 13th St., Racine, Wis.
Greenlee Bros. & Co., 12th and Columbia Aves., Rockford, Ill.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kingsbury Mch. Tool Corp., Keen, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Modern Industrial Engrg. Co., 14230 Birwood, Detroit 4, Mich.
Moline Tool Co., 102 20th St., Moline, Ill.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
National Twist Drill & Tool Co., Rochester, Mich.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
New Jersey Gear & Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Sheffield Corp., Box 893, Dayton 1, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio.
Sundstrand Mch. & Tool Co., 2531 11th St., Rockford, Ill.
Universal Engrg. Co., Frankenmuth 2, Mich.
Verson Allsteel Press Co., 93rd St., & S. Kenwood Ave., Chicago, Ill.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

SPEED REDUCERS
Barnes, John S. Corp., Rockford, Ill.
Boston Gear Works, 320 Main St., North Quincy 71, Mass.
Horsburgh & Scott Co., 5114 Hamilton, Cleveland, Ohio.
James, D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.

SPINDLES, Machine
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.
Standard Electrical Tool Co., 2488-90 River Road, Cincinnati, Ohio.

SPRAYING EQUIPMENT, Metal
Metallizing Eng. Co., Westbury, L. I., N. Y.

SPROCKETS—See Gears, Cut

STAMPINGS, Sheet Metal
Laminated Shim Co., Inc., Glenbrook, Conn.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.

STEEL ALLOYS—See Alloy Steels

STEEL, Cold Rolled, Stainless, High-speed, Tool, etc.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Jessop Steel Co., Washington, Penna.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
Timken Roller Bearing Co., Canton, Ohio.
Vanadium-Alloys Steel Co., Latrobe, Penna.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

STEEL DISTRIBUTORS
Ryerson, Jos. T., & Son, 16th & Rockwell Sts., Chicago 8, Ill.

STOCKS AND DIES
DoALL Co., Des Plaines, Ill.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Landis Mch. Co., Waynesboro, Pa.
Threadwell Tap & Die Co., Greenfield, Mass.

STRAIGHTEDGES—See Machinists' Small Tools

STRAIGHTENERS, Flat Stock and Wire
Bliss Co., E. W., Canton, Ohio.
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
U. E. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

STRIP AND SHEET, Ferrous
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

STRIP AND SHEET, Non-ferrous
American Brass Co., 25 Broadway, New York, N. Y.
Bethlehem Steel Co., Bethlehem, Pa.
Bridgeport Brass Co., Bridgeport, Conn.
Jessop Steel Co., Washington, Penna.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

STRUCTURAL SHAPES
Bethlehem Steel Co., Bethlehem, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

STUD SETTERS—See Screwdrivers, etc.

SUPERFINISHING EQUIPMENT
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.

SURFACE PLATES
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.

SWITCHES, Limit
Allen-Bradley Co., 1331 So. 1st St., Milwaukee, Wis.

TACHOMETERS—See Indicators, Speed

TAP HOLDERS
Brown & Sharpe Mfg. Co., 235 Promenade St. Providence 1, R. I.
Burgmaster Corp., 15001 S. Figeroa, Gardena, Calif.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.

TAPPING HEADS
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Davis Boring Tool Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Jarvis Corp., Stack Ave., Middletown, Conn.
Kato Mfg. Co., Osaka, Japan.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., 1425 Southbridge St., Worcester, Mass.
National Automatic Tool Co., S. 7th & N Sts., Richmond, Ind.
Thriftmaster Products Corp., 1076 N. Plum St., Lancaster, Pa.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

TAPPING MACHINES
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Baush Machine Tool Co., 15 Wason Ave., Springfield 7, Mass.
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.
Cincinnati Bickford Div. of Giddings & Lewis Mch. Tool Co., Oakley, Cincinnati 9, Ohio.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Edlund Machinery Co., Cortland, N. Y.
Elox Corp. of Michigan, Troy, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Kaufman Manufacturing Co., Manitowoc, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Landis Mch. Co., Waynesboro, Pa.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Moline Tool Co., 102 20th St., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

TAPS, Hand, Machine Screw, Pipe, etc.
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jarvis Corp., Stack Ave., Middletown, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Threadwell Tap & Die Co., Greenfield, Mass.
Winter Bros. Co, Rochester, Mich.

TAPS, Collapsing
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Sheffield Corp., Box 893, Dayton 1, Ohio.

TESTING EQUIPMENT, Air, Oil & Water Pressure
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.

THREAD CUTTING MACHINES
Davis & Thompson Co., 4460 W. 124th St., Milwaukee 10, Wis.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., Box 893, Dayton 1, Ohio.

THREAD CUTTING TOOLS
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., Box 893, Dayton 1, Ohio.

THREAD ROLLING DIES—See Dies, Thread Rolling

THREAD ROLLING EQUIPMENT
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio.
National Machinery Co., Tiffin, Ohio.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Waterbury Farrel Foundry & Mch. Co., Waterbury, Conn.

TOOL CONTROL BOARDS
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.

TOOL HOLDERS
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Bridgeport Mches, Inc., 500 Lindley St., Bridgeport 6, Conn.
Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
DoALL Co., Des Plaines, Ill.
Kennametal, Inc., Latrobe, Penna.
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

TOOL MATERIAL, Cast Non-Ferrous Alloy
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Vascoloy-Ramet Corp., Waukegan, Ill.

TOOL MATERIAL, Cemented Carbide
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoALL Co., Des Plaines, Ill.
Kennametal, Inc., Latrobe, Penna.
Metal Carbides Corp., Youngstown 12, Ohio.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

TOOL MATERIAL, Ceramic
Metal Carbides Corp., Youngstown 12, Ohio.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Vascoloy-Ramet Corp., Waukegan, Ill.

TOOL MATERIAL, High-Speed Steel
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
du Mont Corp., Greenfield, Mass.
Jessop Steel Co., Washington, Penna.
Vanadium-Alloys Steel Co., Latrobe, Penna.

TRACING ATTACHMENTS
American Tool Works Co., Pearl & Eggleston Aves., Cincinnati 2, Ohio.
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
Wales-Strippit, Inc., Akron, N. Y.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

TRANSFER MACHINES
See Multiple-Station Machines

TRANSMISSION, Variable Speed
Barnes, John S. Corp., Rockford, Ill.
Boston Gear Wks., Quincy, Mass.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus, Ohio.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

TRUCKS, Material Handling
Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio.

TUBE-FLANGING MACHINES
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.

TUBE FORMING AND WELDING MACHINES
Yoder Co., 5504 Walworth Ave., Cleveland, Ohio.

TUBE MILLS
Yoder Co., 5504 Walworth Ave., Cleveland, Ohio.

TUBING, Non-ferrous
American Brass Co., 25 Broadway, New York, N. Y.
Metal Forming Corp., Elkhart, Ind.
Mueller Brass Co., Port Huron 34, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 18, Ill.

TUBING, Steel
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Metal Forming Corp., Elkhart, Ind.
National Tube Div., U. S. Steel Corp., 525 Wm. Penn Place, Pittsburgh, Pa.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 18, Ill.
Timken Roller Bearing Co., Canton, Ohio.

TUBE & PIPE CUTTING-OFF MACHINES
Grieder Industries, Inc., Bowling Green, Ohio.
Sheffield Corp., Box 893, Dayton 1, Ohio.

ULTRASONIC MCH. TOOLS
Sheffield Corp., Box 893, Dayton 1, Ohio.

VALVE CONTROLS
Barnes, John S. Corp., Rockford, Ill.
Logansport Mch. Co., Inc., Logansport, Ind.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

VALVES, Air
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Div., Mt. Gilead, Ohio.
Logansport Mch. Co., Inc., Logansport, Ind
Ross Operating Valve Co., 110 E. Golden Gate Ave., Detroit 3, Mich.
Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
Skinner Electric Valve Div., New Britain, Conn.
Tomkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich.

VALVES, Hydraulic
Barnes, John S. Corp., Rockford, Ill.
Denison Engineering Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Div., Mount Gilead, Ohio.
Logansport Machine, Inc., 810 Center Ave., Logansport, Ind.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

VERNIERS—See Calipers, Vernier; Gages, Vernier

VISES, Machine
Bridgeport Mches, Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio.
Cincinnati Milling Mch. Co., Oakley, Cincinnati 9, Ohio.
L-W Chuck Co., Toledo 4, Ohio
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Modern Mch. Tool Co., 2005 Losey Ave., Jackson, Mich.
Universal Engineering Co., Frankenmuth 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

WAY COVERS
Futurmill, Inc., Pontiac, Mich.

WELDING EQUIPMENT, Arc
Air Reduction Sales Co., 150 E. 42nd St., New York 17, N. Y.
Lincoln Electric Co., 22801 St. Clair Ave., Cleveland, Ohio.
Linde Co., 30 E. 42nd St., New York 17, N. Y.

WELDING EQUIPMENT, Gas
Air Reduction Sales Co., 150 E. 42nd St., New York 17, N. Y.
Linde Co., 30 E. 42nd St., New York 17, N. Y.

WELDING EQUIPMENT, Resistance
Eisler Engrg. Co. Inc., 750 South 13th St., Newark, N. J.

WELDING POSITIONERS
Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.

WELDMENTS
Bliss, E. W. Co, Canton, Ohio.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.

WIRE
Allegheny Ludlum Steel Corp., Pittsburgh, Pa. (Stainless)
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
U. S. Steel Corp., 525 Wm. Penn Pl., Pittsburgh 30, Penna.
Vanadium-Alloys Steel Co., Latrobe, Penna.

WIRE FORMING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J

WOODWORKING MACHINES
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Greaves Mch. Tool Div., 2011 Eastern Ave., Cincinnati 2, Ohio.
Greenlee Bros. & Co., 2136—12th St., Rockford, Ill.

WRENCHES, Allen, End, Socket, Adjustable, etc.
Allen Mfg. Co., Bloomfield, Conn.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

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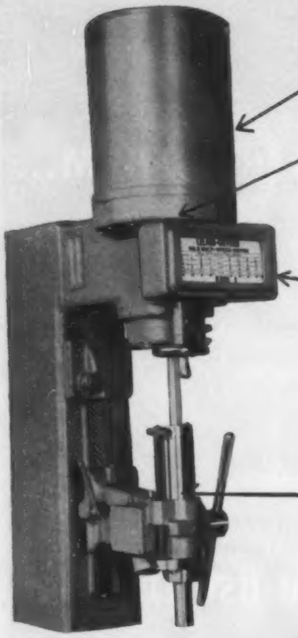


1. TOTALLY ENCLOSED MOTOR
Windings and air gap completely protected from dust, dirt, chips.

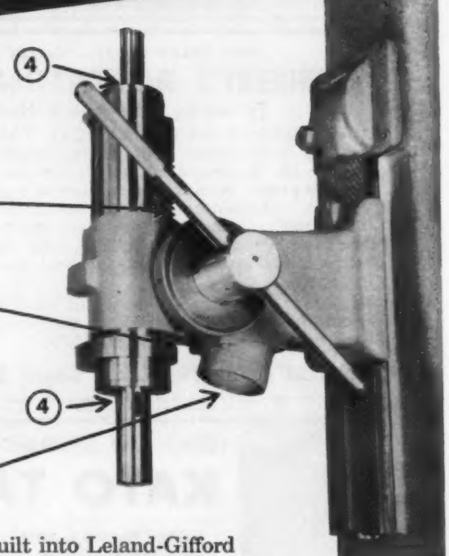
2. DIRECT DRIVE
Direct drive from four-speed motor to spindle for smooth power transmission. For extreme speed range, can be furnished with back gears. Speeds from 90 RPM up to 3600 with torque multiplication up to six times supplies brute power for large drills, ample speed for drills down to 1/16".

3. INDICATING SHIFT
For positive speed indication. Tells right speed to use for drill sizes in three different SFM ranges. Convenient hand wheel shifts speed without stopping machine.

4. OIL MIST LUBRICATION
Radial-thrust ball bearings are constantly and properly lubricated at all speeds by oil mist. Spindle splines lubricated by felt wipers.

5. OVERSIZE SPINDLE QUILL
Oversize quills are 2 5/16" in diameter. Large bearing area maintains accuracy and assures long life.

Only LELAND-GIFFORD Drilling Machines have all these Precision Features



6. INSERTED STEEL RACK
Inserted steel rack prevents radial motion which can cause uneven tooth loads on feed pinion. Also insures accurate alignment when multiple heads are used.

7. BROACHED SLOT
Rack slides in slot precision broached into head.

8. SPINDLE GUARDS
Telescopic guard can be furnished to completely cover the spindle, protect operator from fast-moving multiple splines.

9. BUILT-IN LIGHT
Built into sliding head. Puts the light on the work where it ought to be. Never in the way like makeshift lighting.

Compare the quality, workmanship and precision features built into Leland-Gifford Drilling Machines and you will see why they are the first choice of leading companies for toolroom and production lines.

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